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JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

Entered as second class matter May 7, 1906, at the Post Office at San Francisco, Cal., under the act of Congress March 3, 1879.

VOL. XXIX NO. 24 SAN FRANCISCO, DECEMBER 14, 1912 PER COPY, 25 CENTS

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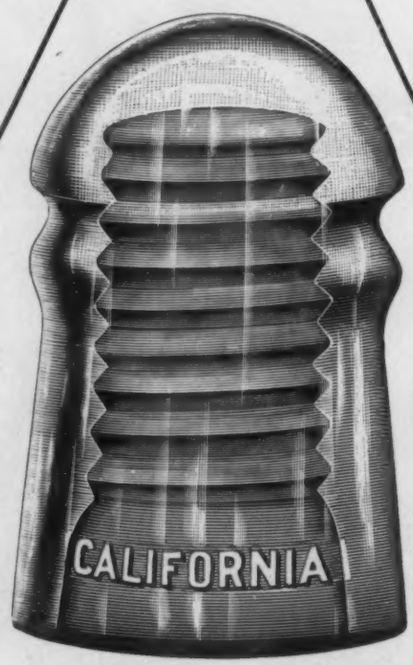

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JOURNAL OF ELECTRICITY
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VOLUME XXIX SAN FRANCISCO, DECEMBER 14, 1912 NUMBER 24

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MODERN STREET LIGHTING[1]

BY C. R. WALLIS.

A brief study of the "Proper Application of Modern Units to Street Lighting" suggests the necessity of defining in general terms what is meant by "Proper Application." Is the value of a unit determined solely by the electrical or lighting efficiency, and is the foot-candle illumination produced on the street surface the only factor to be considered in its application? If so, we can readily see that the problem would be to produce the maximum foot-candle intensity irrespective of physical, physiological or esthetic effects, which is obviously an error, and would be on a par with the early attempts at street lighting that can be summed up in the phrase, "Maximum light for minimum cost."

Graphic Comparison of Illumination With Inverted and Pendant Type Arc Lamps at State Capitol at Sacramento, California.

A consideration of the facts point out that "proper application" can only be defined in terms of effect produced. One authority states that "The ultimate goal of the illuminating engineer is psychological. He strives, with the highest attainable degree of efficiency, to produce desirable visual experiences in those whom he serves." The successful installation is marked by the Illuminating Engineering "finish," which reconciles intensity and distribution with artistic effects, eliminates glare and adds "tone," so we have one harmonious whole, with the lighting units and their field perfectly blended. In other words, the system produces the "ensemble effect" for which it was designed.

In approaching the problem of laying out a system, we must consider the surroundings and the characteristics of the units, or combination of units, that adapts them for this particular field. We must recognize the fact that units of entirely different types cannot generally be used, with good results, in close proximity, due to contrasts in light characteristics.

Since the object to be attained—the effect desired—will vary in different fields, it will simplify the subject to treat it under several distinct classes or groups, as suggested below.

First—General commercial street lighting in business districts of large cities.

Second—The outlying and residential street lighting in large cities.

Third—General street lighting in small cities and towns.

Fourth—Ornamental or display lighting.

Fifth—Park lighting.

Sixth—Parkway and boulevard lighting.

Modern Units.

To meet the requirements of the above fields, there are available the following units:

I—4-ampere d.c. Magnetite lamp, consuming approximately 300 watts (principally series) in:

[1]A paper read before the San Francisco Section of the A. I. E. E., October 25, 1912.

a. Pendant type for general street lighting—most of light in lower hemisphere—maximum ray approximately 10 degrees below horizontal.
b. Inverted type for ornamental lighting in small cities and for residential lighting.
c. Parkway type for boulevard or roadway lighting.

II—6.6-ampere d.c. Magnetite lamp, consuming approximately 500 watts (principally series) in:
a. Pendant type for general street lighting—most of light in lower hemisphere—maximum ray approximately 10 degrees below horizontal.
b. Inverted type for "Great White Way" lighting.

III—Long life flame arc lamps (450 watts up), for a.c. or d.c. multiple or series.

IV—Tungsten filament incandescent lamps in a variety of sizes for multiple and series service.

All of the above units can be furnished with various combinations of glassware and reflectors, thereby giving a wide range of adaptableness.

Characteristics of Units.

Since the characteristics of a unit have an important bearing on its field of application, comparative approximate data on the more important features is of interest.

Type of Lamp.	Color.	C.P. in Max. Beam.	Total Light per Watt M. Sph. C.P.	C.P. per Watt 10 degrees Below Horiz.
250 Watt Tungsten Filament Lamp....	Yellowish White	270	.61	(24" Radial .98 Wave Refl.)*
4 Amp. Magnetite Lamp	White	690	.95	2.23
6.6 Amp. Magnetite Lamp	White	1650	1.36	2.86*
10 Amp. A. C. White Flame (Approx. 500 Watts)	White	1700	1.58	2.62*

*Greater candlepower from 20 degrees to 40 degrees below horizontal.

The above data, with photometric or polar curves, will be useful in determining the type of lamp and the proper height and spacing for specific cases. From the polar curves can be plotted foot-candle curves which will be valuable in readily showing the intensity of illumination at various distances from lamp when mounted at a predetermined height.

Points to Be Observed in Selecting and Mounting Units.

The first, second and third divisions or classes come under the caption of commercial or general street lighting. The many miles of streets that must be served in our American cities, without undue partiality, necessitates efficient and economical means. In the majority of cases the unit must be located at street crossings. However, the modern unit, with superior characteristics, when properly selected and installed, will carry us past the first stage of "merely light."

The major part of general street lighting is of necessity low intensity. To meet the economical demand an efficient light producer must be utilized.

The practical efficient units available have high brilliancy. Extreme brilliancy in the line of vision causes the pupil of the eye to contract, and leads to eye fatigue, thereby reducing the effectiveness of the illumination. Herein enters the physiological demand for properly installing and modifying the high brilliancy units we must use.

I.

(a) For general lighting in principal business streets of large cities select large unit, with most light thrown in lower hemisphere and maximum rays, delivered at slight angle below horizontal. A fair intensity of illumination is necessary to facilitate handling of traffic.

View of Lighting on Hill Street, Los Angeles, With 4-Ampere Inverted Luminous Arc Lamps.

(b) Mount lamp from twenty-five to forty feet above street level to assist distribution and prevent blinding from glare.

Where the character of lighting will permit the use of diffusing globes, the effective illumination will be increased.

(c) Select unit giving white light, as the eye is more sensitive to the short waves.

II.

The statements under I apply to outlying districts, except where economy necessitates the use of smaller units represented by 4 amp. magnetite unit or a combination of magnetite and series incandescent. The proper mounting height, of course, will depend on the unit employed.

III.

(a) The requirements of small cities and towns are almost parallel to the requirements of the streets of lesser importance and outlying districts in the larger cities. The same care in placing lamps should be observed.

IV.

Ornamental or display lighting permits of real treatment by the illuminating engineer, and its success, to a greater extent than any other class, is measured by effect and impression. Though we had daylight intensity uniformly distributed on the streets by means that are harsh and present sharp contrasts between the street and the buildings, the system is not a success. Display lighting carries with it the idea of favorable and pleasing impression. To accomplish this the units must be mounted on ornamental standards in keeping with the surroundings, and the light must be diffused in a manner pleasing to the eye. In order to prevent a sharp line of light at the level of the unit and bring out the architecture of the buildings,

thereby giving the desired impression of good illumination, a large part of the light should be directed above the unit level by suitable globe design. It is an interesting fact that diffusing globes, properly applied, though reducing total light flux projected from the lamp, will increase the effective illumination.

For the best results practice indicates that ornamental units should not be spaced closer than 100 feet, and the best results are obtained by mounting units 12 to 15 ft. above street level.

A single large unit per pole is more effective than a group of small units. It lends grandeur to the lighting scheme and can be operated and maintained more economically.

V.

In the average park we are confronted with obstructions in the way of trees and shrubbery which prevent proper distribution from large units. Again, the field does not demand high intensity. Therefore, the series Mazda lamp, mounted on suitable posts, with diffusing globe, gives a very satisfactory unit. Our principal cities are adopting the single unit standard.

Type of Lamp Standard at Sacramento, California

Illumination of State Capitol at Sacramento With Pendant Type Arc Lamp.

VI.

Parkway Lighting.—The problem presented here is the economical illumination of extensive roadways with heavy automobile traffic. Experiments with low intensity, approaching uniform distribution, utilizing small units closely spaced, vs. high maximum, with low minimum intensities, utilizing large units spaced from 250 to 300 feet, indicate that the latter is more effective.

The small units of relatively high intrinsic brilliancy, placed at a lower height, are found to be detrimental to drivers of automobiles. In case of the parkway lamp (large unit), placed 250 to 300 feet apart, vehicles in the road are seen by silhouette against the splash of light in the distance. This enables drivers to judge distance more correctly without apparent effort. At first an approaching machine will be clearly discerned in the vicinity of the lamp; passing this point, the silhouette of the machine against the light enables drivers to correctly judge position of approaching vehicles.

In the case of low uniform intensity, the approaching machine is blurred and without shadow reliefs, which are necessary for determining distance.

The parkway lamp is the 4-ampere Magnetite, with specially designed globe and reflector, and should be mounted 18 ft. above roadway.

DISCUSSION.

P. T. Hanscom, Chairman: The meeting is now open for discussion. Mr. Armadoux, can you give us some ideas on this subject?

Mr. Armadoux: I would like to know why it is that there is more value obtained in illumination by keeping the units down so low, rather than by using a lamp on a higher pole. In other words, why not set it up higher, and get the effect by placing the lamps more out of the line of vision, thus tending to diffuse the light. It would seem to me that if you do set the lamp up higher, and keep it more out of the line of vision, you would be able to get the same ornamental effect as by putting it down lower, and diffusing the light so that it is cast above the plane of the horizontal. I would like to hear what Mr. Wallis has to say about that.

C. R. Wallis: The efficient units have a high intrinsic brilliancy. It is practically impossible to place units at a height that you can entirely overcome glare without some means of diffusion. You are limited by the cost of poles, and you are also limited in a way by the esthetic effect of tall poles on the street. Again, you have the physiological effect of different intensities, as I pointed out. You may get a higher illumination on the street as measured by a photometer by placing the units higher, without diffusing the globes, but the "effective illumination" would probably not be nearly as good by reason that it is almost impossible to get them high enough to keep the intense ray, which comes from this point of light in the high efficiency unit, from striking the eye, which will cause the pupil of the eye to contract. Therefore, you do not get as much light reflected, from the object which you are illuminating, to the eye. That is where you lose. Does that answer your question?

Mr. Armadoux: I don't know that it does altogether, because it would seem to me that, no matter how you diffused the light, when you keep it down at a height of say 18 or 20 ft. or so, looking down the street, the first lamp in the line of vision you are bound to get a glare effect from it, no matter if you do use a diffusing globe, while if you set that up higher and get more the benefit of the light, you will keep away from the glare.

C. R. Wallis: The lamps in this case have the light sufficiently diffused, so, as a matter of fact, you don't get the glare. The idea of glare would be the intense ray of light projected direct or reflected to the eye from a lamp which has a high brilliancy, which will result, unless the lamp is mounted extremely high.

Mr. Armadoux: At the same time you get that diffusion on the low lamp.

C. R. Wallis: We are working there for effect, not entirely for illumination. If we get a better effect, as has been generally found, by diffusing the light, we have gained a point. In ornamental Mazda installations, you do not think of using the lamp bare without a diffusing globe. In the first place, you don't get the lighting effect. In order to make the system ornamental you cannot have your light projected from a point. You must have it projected from a large surface; and that is the reason that the ornamental lamps and ornamental light employ diffusing globes. I think that can be better understood by observation than by any attempt at explaining. It is a question of psychological effect. From the early days of street lighting—there are some relics in the country where they started in with the high brilliancy open arcs placed at

low height, which led to the idea that street lighting could be better accomplished from towers, in which the lamps were placed very high. In some American cities, such as Detroit (Stockton has some of those towers) they placed the lamps at extreme height above the street. Of course, in doing that and in grouping the lamps, they are lighting a large area; in some cases they are lighting housetops, which is not desired, and, of course, with units of the efficiency we had then, or today, this is out of the question from the standpoint of cost. Tower lighting could be used well for exposition work, where areas are lighted instead of length of street. There is no reason why lamps should not be mounted at great heights except the cost, loss of efficiency, and appearance.

Mr. Armadoux: I wasn't expecting to go to extreme height, but whether a difference of a few feet in height would not give the same effect at less cost than keeping them down so low, and diffusing.

C. R. Wallis: We showed in one slide extremely tall experimental poles at Rochester, N. Y. That is an example along your line, and they found out that using the lamp with a diffusing globe on a lower pole gave a better effect.

Mr. Armadoux: I guess that is something that the eye can see better than anything else.

C. R. Wallis: Exactly.

A. J. Bowie: Mr. Wallis has brought out the fact that the effect of lighting is not merely physical, but is also physiological—which means, of course, that we cannot always reduce it to a mathematical equation. The effect of different colors in lighting is a matter which, it seems to me, is of a good deal of importance. Possibly the personal equation enters a good deal into the case; but I will say that it always seemed to me that Market street (San Francisco) was a great deal lighter when either the arcs or the incandescents were out—when they were not both going at the same time; that the color scheme of the two systems of lighting did not blend at all; and I would like to ask Mr. Wallis if the effect of mixing colors has received much recognition from illuminating engineers? If it has, it would seem to me that it would be unadvisable to combine generally the light of white arcs with the lighting of incandescents, such as happens in downtown districts. In other words, in such districts it would be better, if you used arcs at all, to us the flaming arc of yellow color.

C. R. Wallis: That question has received consideration by various engineers, and experiments have been made in putting in different installations, where they could not get the proper effect with one unit. In Atlantic City they made some experiments there in lighting the board walk. They wanted to get light on the board walk so that people could recognize each other. They also wanted a well-distributed light over the whole area. Mazda lamps in clusters were placed about twelve feet from the ground, and on top of the pole, which was twenty or twenty-five feet. They tried different styles of arcs to find out which type would give the better effect. They tried the magnetite and enclosed carbon. (I don't know whether they tried the flame or not), but found that the contrast between the Mazda lamp and the magnetite was such that the general effect was undesirable, so they finally adopted the enclosed carbon arc for that purpose. The light of the enclosed carbon arc and the Mazda lamp seemed to blend much better.

Another example of this is in Washington, D. C. I have seen some unfavorable comments from using the magnetite lamp and the Mazda lamp in combination for street lighting. The effect is not at all good. Most illuminating engineers have considered the subject in one way or another, and they have dealt with the color scheme. It has been pointed out that color has advantages or disadvantages in various classes of street lighting. For low intensity, white light gives the best results, because the eye is more sensitive to white. Where you have a high intensity for display lighting the effect of the yellow light is good. It brings out the detail better than the white, but, on the other hand, yellow is more distinctive to sign lighting.

A. J. Bowie: I understand from that that it would be the general tendency of practice of the companies manufacturing lamps to recommend in the downtown districts not the magnetite lamp, but the flaming arc, or don't they recommend the flaming arc because they mix in with the sign lighting and effect illumination of the windows?

C. R. Wallis: The manufacturers have not taken any stand on that point at all, as far as recommendation of the two lamps goes. There are various commercial considerations which would determine the use of the lamp. As a matter of fact, although a yellow light may bring out detail of the buildings better than a white light, I think for general ornamental lighting that the white light given by the magnetite lamp is more effective. I have noticed in installations that have been made that the contrast between the white light diffused from an Alba globe and sign lighting in that class of work, is effective. Looking down the street where you have a number of signs, there is a contrast there which gives a pleasing effect.

A. J. Bowie: You don't think the yellow light is superior necessarily where it has to mix with the sign lighting?

C. R. Wallis: Personally I do not think so. I believe that the contrast between the sign lighting and your display lighting is desirable. It certainly makes your signs more effective.

A. J. Bowie: It may make the signs effective, but does it make the street more attractive?

C. R. Wallis: I think so.

Henry Bosch: I should like to ask Mr. Wallis with reference to the pendant type of lamp for street illumination, what is the recommendation of the spacing of lights?

C. R. Wallis. A 4-ampere magnetite is generally mounted from eighteen to twenty-five feet.

Henry Bosch: Do you find that is really the most desirable height?

C. R. Wallis: We find that twenty-five feet to thirty-five feet is the most desirable height for lamps spaced 350 to 400 feet apart (which is the average block)—a lamp thirty-five feet above the ground, the maximum ray 10 degrees below the horizontal, will strike the ground about midway.

Henry Bosch: I had in mind the spacing of your large units and the smaller ones shown in your exhibit.

C. R. Wallis: I intended to represent by the smaller lamp the placing of small units, as would ordinarily be carried out for giving a low uniform intensity.

Henry Bosch: That is a characteristic of park lighting?

C. R. Wallis: That particular case was intended to represent parkway lighting. Of course, you understand, that would be a small scale.

Henry Bosch: I catch the point, but you show it is more favorable to use a unit of higher intensity than to use numerous smaller units.

C. R. Wallis: Exactly. If you are going to produce low uniform intensity, you necessarily must use a smaller unit, and all we have available for that is either the incandescent units or gas units.

C. R. Wallis: Experimentally. Fourteen feet six inches is not intended for height of parkway lamp. This should be mounted 18 feet above roadway.

Henry Bosch: Is there any objection to the pendant type of lamp for park illumination?

C. R. Wallis: There is no objection other than from the standpoint of ornamentation and size of unit. In the parkway lamp a reflector is used above the lamp, and practically all the light is delivered in the lower hemisphere; a diffusing globe is also employed to prevent any glare.

R. B. Hussey: I might say one thing in regard to the

color of street lights. A good example of the difference between the white light and the yellow, in comparing Federal street, in Allegheny, and Broad and Market streets, in Newark, N. J., I think the result is largely a matter of personal opinion as to which one you will consider the best. The lighting in Allegheny is with white flame arcs, and in Newark with yellow flame arcs. Now Newark is supposted to be lighted about as intensely as any city there is; that is, that particular part of Newark, and it is so intense that it detracts very largely from the sign lighting—so much so that the signs are practically inconspicuous; and it also detracts from window lighting. That is a point which is of great importance, I think, in connection with power companies. It depends largely on local conditions as to whether it is best to light the street at high intensity and lose the window lighting or light the street perhaps to a somewhat lower intensity and have good window lighting; and that also applies to sign lighting. Take Broadway, New York, for instance, the regular street lighting is entirely lost; it is inconspicuous. The White Way is entirely from the signs that are placed so conspicuously along Broadway, and that makes its name. You go over to Fifth avenue, and your lighting there is entirely from regular street lighting. If I remember correctly, they have six lamps to a block, and they are so arranged that there are four lamps at the street intersections and two lamps midway in the block, on the opposite side of the street.

There is a point in connection with that which I do not think has been touched on tonight at all, and that is this: With an effect perhaps similar to that which we have on this illuminated plat here, the lighting down the street is uniform throughout the length of the street, and it is difficult to distinguish street crossings. The lighting in Ontario, Canada, is entirely with tungsten lamps, and they installed lamps throughout the street to give a somewhat similar effect to this, and it was found there they had some difficulty at first at the crossings, due to the fact that the lighting there was of the same intensity as in other parts of the street, and it was difficult for approaching vehicles to be distinguished, or rather to distinguish the crossing, which, of course, is the point of maximum travel in the street.

There is another point in regard to the relative merits of uniform and nonuniform background to get your silhouette effect. If I understand Mr. Wallis correctly, the idea that he has is that lamps placed, say, 400 feet apart, or 350—whatever your average street length may be—in giving a fairly high intensity immediately under the lamp at the street crossing, makes a bright point against which you object or machine is seen in silhouette. Now, on some of the slides that were shown you get a uniform background and fairly high intensity; and it seems to me that your silhouette effect would be as great or greater with a background of that kind than it would be with the lamps spaced so far apart. That, of course, is a point which is rather difficult to demonstrate one way or the other, I think. It is rather difficult to demonstrate it in actual trial; and it is difficult to demonstrate it by an actual installation. But I think the effect would be perhaps better with the more uniform lighting.

There is one other point in regard to the height of the poles. There was some discussion about 14½ feet. When you place a lamp at that height with the distribution characteristics as given, you get, as you notice here, a rather intense light immediately under your lamp; and in the center of the street the lighting is not as great; and there is considerable difference between the maximum and the minimum intensity along the street. Now it seems to me that if those lamps were placed at nearly double the height, you would get a good deal more uniform illumination, and it would probably be less difficult to traverse the street. That is, the eye, as you would travel along the street, would not have to change from a condition of fairly or very high illumination to one of lower illumination, which change is rather fatiguing. If the lamps were placed further apart and higher, I think the effect would be better. The wattage, of course, per foot of street would be less, but I think the result in the end would be more pleasing, and the street would be more easily traversed.

C. R. Wallis: In connection with the remarks of Mr. Hussey, I want to say that this scheme in practice partly utilizes the ideas which he has expressed. In the exhibit we are considering an example of roadway lighting, and in that case your lamps are placed a good deal higher than is shown. You have a certain amount of money with which you can maintain a system. Instead of putting that money into a low uniform system, a system that will give you a low uniform light, experiments indicate that much better results can be obtained by using large units placed on the poles as indicated, some 300 feet apart. These statements do not apply literally to display lighting, as indicated by reference made to the slides. In this case we have a relatively high intensity. The objection to placing poles close in ornamental display lighting is at least two-fold. If we use a low intensity with the smaller unit, we will have a regular forest of poles on the street; whereas, by spacing the units further and having a reasonable maximum and minimum, the general results, I believe, are better. In each case we have the commercial side to consider. By spacing the units further, and using a larger unit, we may keep up the minimum and have a higher maximum, which gives us the shadow of relief.

Mr. Hussey: I think it depends very largely upon whether you are discussing high intensity or medium intensity installation; that is, high intensity comparatively, such as you have in a city district, or low intensity comparatively, such as you use in an outlying district.

Now with the city district, where the intensity is high, there isn't as great a necessity for uniformity of intensity as there is where the light is of lower average intensity; that is, if you are working where your lamps are 400 feet apart, you are working at a point where you are slowly traveling from low to high intensity, which, at the low intensities you are using, is very fatiguing to the eye.

C. J. Wilson: One point as to the placing of the lamps, particularly in outlying districts. I think if we consider the photograph as illustrating the effect of light and shadow on the eye, and compare the photograph which has low contrast with one which has very much contrasted shadows and high lights, the photograph having no shadows in it is not usually considered artistic or pleasing to te eye, while a photograph having considerable shadow effect is much more effective and more pleasing.

In the same way the distribution of light in an outlying district, especially driving at night, I don't agree with the gentleman who states that it is fatiguing to the eye. I think the effect is not at all fatiguing, and at the same time objects appear more in contrast by passing from a high light to a fainter light; and I think it is much easier to travel with that type of lighting along the street. Now the units to be used to obtain that effect, the magnetite unit, I think, has an effective ray 10 degrees below the horizontal about 2.23 candle power per watt, if I understood Mr. Wallis correctly, while the less intense units, such as the tungsten or magnetite light, have effective candle power of only about one candle power per watt. The spacing of the lamps with the higher intensity of ray 10 degrees below the horizontal can be considerably greater with the same consumption of current. For that reason I think you get the advantage of more light for the amount of current used and more effective illumination. Of course, for what might be termed ornamental lighting, electrolier lighting and such lighting as that, the smaller united spaced closer seem to be more effective, particularly in downtown districts, where there has seemed to be a demand for more intense illumination on the street.

READINESS TO SERVE METHODS

METHODS OF APPROACH.

BY ROSS B. MATEER.

Much has been written on commercial policies and the utopian principles underlying the efficient and progressive business-getting organization.

Rules have been made, and frequent rehearsals on the part of the soliciting staff, which would, it seems, result in an army of aggressive and efficient salesmen, interested in promoting the sales of "juice." Book knowledge, it seems, is provided in large quantities, but is similar to the theory advocated by the scientist, and seldom brings practical results. Practice, not theory, is what is needed to-day in developing agricultural sales. A generous response by the central stations to the appeals for modern conveniences consist in granting liberal extensions of line and in maintaining an aggressive agricultural sales department, not in turning a deaf ear, and assuming a general attitude of "go to blazes."

An extensive campaign for developing current sales by the use of appliances may be characteristic of the companies in some cities, but in the great majority the elaborate display of bright, current-consuming utensils and motors remain within plate glass cases, and even the urban resident approaches the sacred cabinet with trepidation. Admitting that such a spirit is to be found in the city, can a quasi public utility expect the farmer, who is the producer of riches, to view motor-operated and current-consuming apparatus with the awe of the urban resident when appreciative of the apparatus for its value as shown by an increase in productiveness? Will the lighting company's approach to the customer be such as will invite and receive his confidence, commanding his respect and encouraging in him a spirit of co-operation?

Methods of approaching prospective consumers are many, and yet no two are identical in that they have resulted in revenue for the utility and increased production to the farmer.

Few, if any, agriculturists are of a technical mind and all references to technical phrases should be omitted when discussing a proposed installation.

Do not dally on the voltage or general mechanical advantages of the apparatus, nor be content in quoting the price per kilowatt. The vital part of your argument is what the farmer must pay for his "juice," that he may produce a more prolific tree or vegetable, and what percentage of his probable returns from the crop does his power bill represent.

Should actual figures be necessary, it is worth while to have them accurate and permit a close check between the estimated bill and that rendered per annum.

Be a judge of "human nature," learn to act quickly, distinguishing, if you please, between the conservative and the "never-to-be-interested" prospects. Some may admit all your arguments, but delay a decision, while a few may leap before giving the proposition mature consideration. Come back another day where your presence is desired only for companionship. Rather devote your time to those of the progressive and conservative type, who believe when actual profit is in evidence.

Do you ride a "hobby"? Many do, and its path frequently leads to the actual contract. A general knowledge of current events is not without value where the man with a "hobby" is at issue.

Perfection is to-day found in no man, neither is all knowledge bound in one frail human casing. When discussing a point at issue and you are not quite sure, it is better to ask a few questions which may shed additional light, permitting of an answer at par. Then your knowledge will be properly rated in the mind of the farmer, and unaffected by the "bull or the bear."

Be prepared to quote on installations of a similar character, bearing in mind some average statement as to cost.

In closing, it is suggested that the sales engineer approach his prospective consumer upon a friendly basis, encouraging the friendship of his prospect. Be interested in what is of moment to him. Aim to provide such installations as are the best from the standpoint of economy and service to the consumer. Pave the way for additional current consumption by aiming at the mark and with accuracy, maintain the parity of your stock. Aim to build up such an output of current in the rural districts that what is sometimes considered the tail of the public utility will ultimately wag the entire organization.

Experimental, pioneer, co-operative, or whatever term be applied to the development of current for farming purposes, it is not too much to predict that as the industrial business superseded that of the illuminating from a revenue-producing standpoint, so will the agriculturist rank first from that of load factor.

Talk to the farmer in his language, the increase yield per acre through a generous supply of water and the cost of such water per season. He knows his yield in sacks of beans per acre, or hundred-pound sacks of potatoes. He speaks in tons of alfalfa per acre, not in the rate per kilowatt.

He knows the water is necessary; how can it be delivered at a minimum of cost and what is the expense per acre foot?

PRESUMPTION FROM FAILURE TO CALL WITNESS.

In the Patent Office proceedings of Steinberger vs. Hewlett the following interesting ruling was brought out August 6, 1912:

Where in a case involving the question of originality an inventor fails to take the stand who is available as a witness when the facts in his favor, if any there be, the peculiarly within his knowledge, the legal presumption follows that his testimony would be unfavorable to his case.

INVESTIGATION OF TRANSMISSION LINE PHENOMENA.[1]

BY E. H. LE TOURNEAU AND E. D. SEARING.

The series of tests represented by the oscillograms shown in this paper were inaugurated primarily in an attempt to discover and assign causes for failures of suspension type insulators on the steel tower transmission line of the Portland Railway, Light & Power Company, and also for various phenomena occurring at time of switching operations.

The steel tower transmission line has been described in a previous paper before this section of the American Institute of Electrical Engineers.[2] The line is 27.6 miles long, the conductor being 250,000 c.m. hard drawn copper strand, supported on suspension insulators in a vertical plane on one side of double circuit steel towers. At the present time approximately nine miles of the line is of temporary construction and is composed of No. 0 copper strand supported on 60,000 volt insulators on wooden poles and crossarms in a horizontal plane. There are at the present time no tap connections made to the line although the line was operated for several months with a tapped connection near the Portland and which extended to Beaverton, Oregon. There are no transpositions in the line. The line operates at 60 cycles and approximately 60,000 volts with neutral grounded and is protected at both ends with aluminum cell lightning arresters.

There were obtained a total of 175 oscillogram records, nearly all of which were taken during the night or on Sundays on account of operating conditions. For convenience in comparing results, the tests have been grouped as follows:

A. Switching off and on the line by high tension oil switches.
B. Switching transformers off and on to line by high tension oil switches.
C. Switching off and on line and transformers by high tention oil switches.
D. Switches off and on line and transformers by low tension oil switches.
E. Switching transformers on to operating system by closing low tension oil switch.
F. Opening line with high tension oil switch when carrying load.
G. Effect of switching on line when fused to ground.
H. Effect of charging lightning arresters.
I. Voltage, induced by parallel lines.
J. Switching off and on line with connected load by high tension oil switches.
K. Switching 11,000 volt lines.
L. Effect of synchronizing.
M. Open circuit wave forms and normal operating conditions.
N. Telephone line tests.
O. Switching off and on open line by air break switch.
P. Opening line with air break switch when carrying load.
Q. Time of closing switch contacts.

As will be noted from the preceding tabulation, the tests originally outlined led to a number of secondary investigations, interesting in themselves as considered separately from the main subject. The results which can be derived from a comparison of the records will be tabulated under the headings given above and typical oscillograms shown.

[1]Paper presented before Portland Section, A. I. E. E.
[2]See April 6, 1912, Journal of Electricity, Power and Gas.

A. Switching off and on open line by high tension oil switches.

The high tension oil switches at the River Mill generating station for connecting the line and transformers to the station bus are of the steel tank type manufactured by the General Electric Company and known as the Form K-10 switch. The switches for use on the 11,000 volt circuits, which is the voltage of generation, are known as Form K-12. The high tension switches as well as the 11,000 volt switches at Lincoln substation are also of General Electric make and are known as Form H-3.

The time required to completely disconnect the line with the Form H-3 oil switch, as indicated by the disturbance caused in the current and voltage wave forms is approximately 2 cycles, while that required by the Form K-10 switch is 5½ to 6 cycles. In the same way, time required for conditions to become normal upon closing the circuit with Form H-3 oil switch is approximately 1 cycle while the time required with a Form K-10 switch is 2 to 2½ cycles. The rise in voltage, varies in the different records, due largely to the point of the voltage cycle at which the switching operation commences and to the length of time required to complete the operation. In the case of switching off the line with the Form K-10 switch, the instantaneous maximum of voltage on the line during switching exceeded the instantaneous maximum of the normal wave by an average of 43 per cent representing observations made on the end of the line at which the switching took place and by an average of 68 per cent representing observations made on the opposite end of the line. When switching off the same line with Form H-3 switch, the instantaneous maximum of voltage on the line during switching exceeded the instantaneous maximum of the normal wave by an average of 23 per cent, representing observations made at the end of the line at which the switching took place and by an average of 40 per cent, representing observations made at the opposite end of the line. In the same way when switching on the same line with the Form K-10 switch, the rise above normal was 30 per cent at the same end and 65 per cent at the opposite end of the line and with the Form H-3 switch the rise above normal was 12 per cent at the same end and 17 per cent at the opposite end of the line.

These test records indicate that the Form K-10 switch causes a greater disturbance on the line than the H-3 switch, and in either case the disturbance is greater at the end of the line remote from than at which the switching is done.

In addition to the effect upon the voltage conditions of the line itself caused by switching on and off the steel tower transmission line, there is a decided effect upon the voltage conditions of the station or system to which it has been, or will be connected, in some cases exceeding the voltage rise on the transmission line itself.

In one instance the line was switched off from the River Mill generating station and the voltage rise was sufficient to jump across the terminals of a 57,000 volt potential transformer connected to the bus, a distance of 10½ in.; this short-circuit caused the generator switch to open automatically. The rise in voltage as shown on the oscillogram was approximately

58 per cent, or an instantaneous value of approximately 137,000 volts.

Also the effect upon the entire 60 cycle system was very marked when the tower line was switched off or on. A convenient method of observing this was obtained at the River Mill Station where a tap from the Cazadero line enters. A voltage rise as high as 39 per cent was observed at this point when the tower line was switched off at the Portland end at Lincoln Substation, requiring that the disturbance be transmitted through two banks of transformers, and the 11,000 volt cables and overhead lines in Portland.

In order that the measurements of voltage on line might represent actual line voltages, the choke coils were short circuited at River Mill, placing the potential transformer connections directly on the line. This arrangement was not necessary at the Lincoln Substation end of the line, since the temporary connections to potential transformers were made outside of the choke coils.

In a number of instances, the aluminum electrolytic lightning arresters operated and this, no doubt, prevented the voltage from reaching even higher values than those shown on the record curves.

Some question was raised with reference to the use of potential transformers for measuring high frequency surges of voltage, and it was thought that there might possibly exist even higher frequency surges than those shown on the records obtained, and that these high frequency variations would be damped out by the potential transformer iron. In order that this might be investigated, a non-inductive resistance was constructed by using approximately 12,000 ft. of No. 28 B. & S. gage "Climax" resistance wire. This wire was mounted on wooden frames, suspended from insulators and a current of approximately 9/10 of an ampere was allowed to flow from the line to ground through this 400,000 ohm resistance. One vibrator of the oscillograph was shunted across a small portion of this resistance and one vibrator of the oscillograph connected to a potential transformer on the same phase with the non-inductive resistance. The curves obtained with these two vibrators were almost identical and not only proved that the potential transformer was satisfactory in recording voltage variations up to the limit of frequency, which could be recorded with the oscillograph, but also showed in a remarkable way the reliability of the oscillograph in duplicating the very high frequency surges obtained.

B. Switching transformers off and on to line by high tension oil switches.

In these tests the three 3667 k.v.a. 3-phase transformers were simultaneously thrown off and onto the transmission line by opening and closing high tension line oil switch, the low tension side of transformers being open. Here again the use of the Form K-10 switch causes slightly more disturbance than the use of the Form H-3 switch but the disturbance is greater at the end of the line at which the switching is done.

The rush of current upon closing the circuit to the transformers is very clearly shown in the records obtained, reaching an instantaneous peak of over 100 amperes of current taken from the line. These instantaneous surges of current decrease with each cycle, always occurring on only one side of the zero line, until in about 20 or 25 cycles a uniform wave is obtained in which the harmonics are nearly of equal magnitude with the fundamental. Also the curve shows plainly how the current changes from approximately 90 degrees leading to approximately 90 degrees lagging by the omission of one-half of a cycle. The explanation of the swings of current on only one side of the zero line would seem to be that the residual magnetic flux exists in one direction and it requires approximately one-third of a second to restore complete reversal of magnetic flux.

Similar tests were also made on the transmission line from the Cazadero power station to the Knott substation in Portland. This line is of wooden pole construction entirely and has two taps taken from it feeding Lents and Tabor substations respectively. The switching on and off of transformers on this line, designated as No. 57602, has practically no effect upon the voltage, simply causing a slight variation in wave form. The neutral current shown in these records is an almost pure third harmonic when line only is connected but has also a fundamental component when line and transformers are connected.

C. Switching off and on line and transformers by High Tension oil switches.

In the records shown as representing these tests, three 3667 k.v.a. 3-phase transformers were connected on the high tension side to the line with the low tension side open and the high tension oil switch on the opposite end of the line opened and closed. In these tests again the Form K-10 switch causes the greater disturbance and the voltage rise is greater at the end of the line opposite to that at which the switching is done, i.e., the greater disturbance occurs at the point between line and transformers as would be expected.

In one of the records shown the arc across the switch terminals was re-established after the line voltage had become practically zero and in one case high frequency surges were set up between line and transformers, of the order of the seventh harmonic which is the principal harmonic existing in the normal voltage wave.

D. Switching off and on line and transformers by low tension oil switches.

These tests were performed by opening and closing the 11,000 volt oil switch on the low tension side of transformer, the high tension side of which was already connected to the open transmission line. In some of the tests the high tension sides of two other transformers were also connected to the line, the low tension side being open. The records obtained while switching off show very little disturbance, the voltage gradually dying out in two or three reversals occupying more time than a fundamental cycle. In switching on, however the phenomena became more complex. In one record after two complete cycles of apparently normal conditions a series of surges is set up in the entire system and a peak of 41 per cent above the instantaneous maximum of normal wave is obtained on the tap from the Cazadero line which enters the River Mill Station. Record No. 251 seems to mark a very pronounced series of surges after eight complete cycles

have elapsed from the indicated closing of the switch. A satisfactory explanation of the voltage record shown on the film has not been obtained. Possibility of faulty contacts in the oil switch led to the series of tests under heading "Q." The test was repeated a number of times, but a like result was not obtained. A very interesting record was obtained, in which the instantaneous value of current on one side of zero line reaches approximately seven times its previous maximum, and after the completion of two cycles the magnetization of the iron seems to completely reverse itself so that the higher peak value of current occurs on the opposite side of zero line. A noticeable feature is the very high frequency of the current at the instant of switching.

E. Switching transformers on to operating system by closing low tension oil switch.

This test was made to ascertain if the drop in voltage which occurs on system when these transformers are switched on was accompanied by marked surges of voltage. This does not seem to be the case, and the drop in voltage seems simply to be due to first rush of current into transformers.

F. Opening line with high tension oil switch when carrying load.

These tests were made by opening the Form K-10 oil switch on line at River Mill Station when line was carrying regular system load, the load being transferred to othe stations. The load was dropped with no disturbance whatever, as the records show. An interesting point is the increase of line current at the instant of opening.

G. Effect of switching on line when fused to ground.

In order to perform this test a piece of No. 30 B. & S. gage copper wire about 20 ft. long was connected between the lower leg of line and ground near Lincoln substation. The high tension oil switch was closed, energizing the line in this condition from a generator at the River Mill Station. In one record the line was energized from turbo-generator at Station "L." The peak value of potential on the turbo-generator was 72 per cent above the instantaneous maximum of the normal wave. In Record No. 252 the fuse instantly burned off and the generator oil switch did not open automatically as in other cases. The upper leg of line reached a maximum potential to ground of 89 per cent above instantaneous maximum of normal wave. Pictures were taken of the flash when the wire fused.

H. Effect of charging lightning arresters.

Although the charging of lightning arresters appears to have practically no effect upon the voltage wave of the line, a very interesting series of records were obtained. In Record No. 141 the effect of charging lightning arresters upon the current in transformer neutral is recorded. The normal transformers neutral current is found to exist of a 33-cycle fundamental. Also, the wave shape appears to nearly duplicate itself every fifth cycle, which is explained by the relation of time required for five 33-cycle waves being approximately equal to the time required for nine 60-cycle waves. The existence of a 33-cycle wave in the neutral of the 60-cycle transformers is explained by the arrangement of the 33-cycle transmission lines paralleling the 60-cycle lines. In the part of the steel tower line, which is temporarily supported on wooden pole construction, the 33 and 60-cycle lines are on the same poles, the 33-cycle line occupying the top position and being arranged in an equilateral triangle, and the 60-cycle line is a horizontal plane, with two conductors 34 in. apart on one side of pole, and the third conductor 68 in. from nearest conductor on the opposite side of the pole. The 33-cycle neutral current is evidently the result of unbalanced induction from the 33-cycle line paralleling the 60-cycle line. In Record No. 141 the 60-cycle line is open at one end, and the effect of the 60-cycle current is not very marked, while in other record taken the 60-cycle line is carrying load, and the 60-cycle current, representing slight unbalance, predominates; another record shows the current in one tank of the lightning arrester as well as in the ground connection from all three tanks while the arrester is being charged. The ground current shows the third harmonic as would be expected while the eleventh harmonic predominates in the charging current for one tank only. The effect of charging lightning arresters upon telephone lines was investigated. The normal wave induced in the telephone line is a combination of 33-cycle and 60-cycle voltage with the high harmonic greatly increased by charging arresters.

I. Voltage induced by parallel lines.

This test was made by connecting the oscillograph to potential transformer on tower line, which was open at both ends. The 60-cycle wave was taken from the station bus for purposes of comparison.

The remarks concerning transformer neutral current apply to the induced voltage waves. The waves repeat themselves every fifth cycle. The 33-cycle wave predominates, on account of the proximity of the 33-cycle line to the line in which the voltage was induced. The other 33-cycle line and 60-cycle line have their effect, however.

J. Switching off and on line with connected load by high tension oil switches.

There are two substations tapped on to the Cazadero line, and hence the switching on and off of this line represented the switching of a loaded line. The disturbance was not very marked in either case, except in the case of the neutral current shown on Record 210. The gradual reduction in voltage and frequency shown on Record 209 is undoubtedly due to the presence of rotating machinery on the line.

K. Switching 11,000-volt line.

This field of investigation was hardly touched upon. No effect of switching cables was discernible in wave form of high tension transmission line voltage.

L. Effect of synchronizing.

One record shows a slight surging of current in the line after synchronizing. The actual instant of closing the switch is not shown.

N. Telephone line tests.

Some of these tests have already been referred to and the effect of charging lightning arresters upon telephone lines noted. Record No. 216 was taken as the voltage wave form induced in the telephone line,

Line energized from 60-Cycle System at Lincoln Substation.

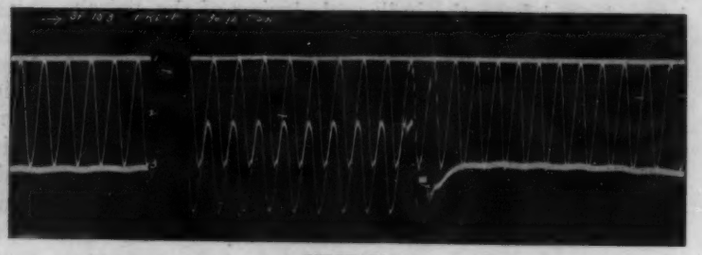
Observations made at Station "M."

Note: During this test Transformers Nos. 1, 2 and 3 were connected to 11,000-volt bus and 57,000-volt bus at Lincoln Substation, neutral of No. 3 transformer grounded. Line No. 57605 was open at Station "M" and energized from Station "G" through Line No. 57602 which was carrying 60-cycle system load.

Curve 1—I = Current in ground connection from lightning arrester tanks. No discharge.

Curve 2—E = Potential between middle leg of Line No. 57605 and ground, 300:1 ratio potential transformer. Peak value of potential to ground = 39% above instantaneous maximum of normal wave, approx. 68,000 volts. Normal = 34,500 volts effective, taken from switchboard reading.

Curve 3—E = Potential between middle leg of Line No. 57604 and ground, 300:1 ratio potential transformer. Peak value of potential to ground = 22% above instantaneous maximum of normal wave, approx. 57,000 volts. Normal = 33,000 volts effective, taken from switchboard reading.



TEST "A."

Switching Off Line No. 57604 by Opening Form H-3, 57,000-Volt Oil Switch at Lincoln Substation, Line Open at Station "M."

Line energized from 60-Cycle System at Lincoln Substation.

Observations made at Lincoln Substation.

Note: During this test transformer No. 3 was used at Lincoln Substation, neutral grounded.

Curve 1—I = High tension line current, 30:1 ratio current transformer. Peak value of line current = 36 amperes approx.

Curve 2—E = Potential between lower leg of line and ground, 300:1 ratio potential transformer. Peak value of potential to ground = 34% above instantaneous maximum of normal wave.

TEST "A."

Switching Off Line No. 57604 by Opening Form H-3, 57,000-Volt Oil Switch at Lincoln Substation, Line Open at Station "M."

Line energized from 60-Cycle System at Lincoln Substation.

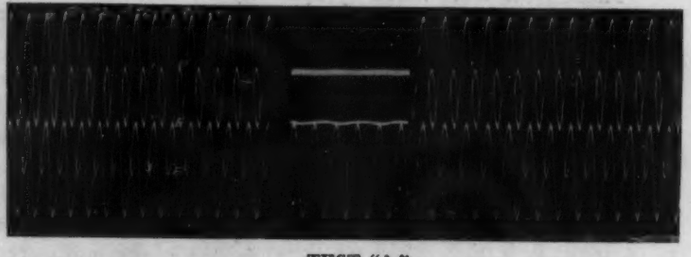
Observations made at Station "M."

Note: During this test transformer No. 3 was used at Lincoln Substation, neutral grounded. Line No. 57605 was open at Station "M" and energized from Station "G," through Line No. 57602, which was carrying 60 cycle system load.

Curve 1—E = 57,000-volt station bus potential, 500:1 ratio potential transformer. No rise of bus potential.

Curve 2—E = Potential between middle leg of Line No. 57604 and ground, 300:1 ratio potential transformer. Peak value of potential to ground = 9% above instantaneous maximum of normal wave.

Curve 3—E = Potential between middle leg of Line 57605 and ground, 300:1 ratio potential transformer. Peak value of potential to ground = 17% above instantaneous maximum of normal wave.



TEST "A."

Switching on Line No. 57604 by Closing Form H-3, 57,000-Volt Oil Switch at Lincoln Substation, Line Open at Both Ends.

Line energized by Generator No. 2 at Station "M."

Observations made at Station "M."

Note: During this test transformers Nos. 1, 2 and 3 were connected to 57,000-volt bus at Station "M." 11,000-volt switches open on Transformers Nos. 1 and 3. Transformer No. 2 connected to No. 2 generator. Transformers Nos. 1, 2 and 3 were connected to line No. 57604 at Lincoln Substation. 11,000-volt switches open. Neutrals of all transformers grounded. Form K-10 oil switch was opened between transformer No. 2 and high tension bus.

Curve 1—I = High tension line current, 30:1 ratio current transformer. Peak value of line current = 9 amperes approx.

Curve 2—E = 57,000-volt sta. bus potential, 500:1 ratio, potential transformer. Peak value of bus potential = 29% above instantaneous maximum of normal wave.

Curve 3—E = Potential between middle leg of line and ground, 300:1 ratio potential transformer. Peak value of potential to ground = 29% above instantaneous maximum of normal wave.

TEST "C."

Switching Off Line No. 57604 by Opening Form K-10 Oil Switch at Station "M." Transformers Connected to Line at Lincoln Substation.

Line energized from 60-Cycle System at Lincoln Substation.

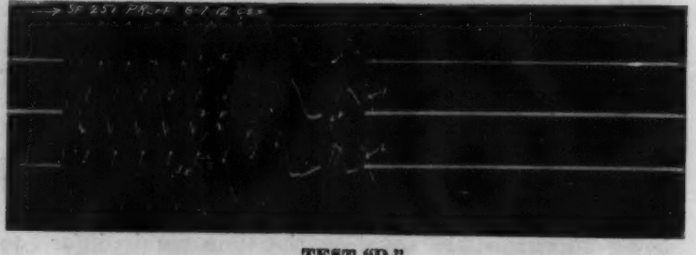
Observations made at Lincoln Substation.

Note: During this test transformers Nos. 1, 2 and 3 were connected to 57,000-volt bus at Lincoln Substation, neutral of transformer No. 3 grounded. Resistance used for curve No. 1 was approx. 12,000 feet of No. 28 B. & S. gauge Climax resistance wire supported on wooden frames.

Curve 1—E = Potential between lower leg of line and ground, measured by taking drop across shunt in series with approx. 40,000 ohm non-inductive resistance (see note). Peak value of potential to ground = 42% above instantaneous maximum of normal wave.

Curve 2—E = Potential between lower leg of line and ground 300:1 ratio potential transformer. Peak value of potential to ground = 54% above instantaneous maximum of normal wave.

Curve 3—E = Potential between middle leg of line and ground 300:1 ratio potential transformer. Peak value of potential to ground = 40% above instantaneous maximum of normal wave.



TEST "D."

Switching On Line No. 56704 by Closing Form H-3, 11,000-Volt Oil Switch at Lincoln Substation, Line Open at Station "M."

Line energized from Station "M." Transformer neutral grounded.

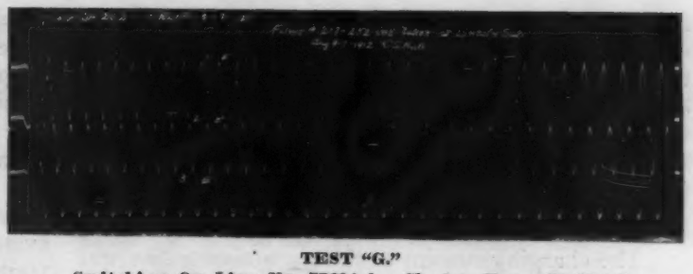
Observations made at Lincoln Substation.

Note: Fuse of about 15 feet of No. 30 B. & S. gauge copper wire was connected between lower leg of line and ground near Lincoln Substation. The short circuit was not sufficient to automatically open oil switches at Station "M." Lightning arrester discharged at Lincoln Substation. Oscillograph vibrator used in curve No. 1 broke.

Curve 1—E = Potential between upper leg of line and ground, 300:1 ratio potential transformer. Peak value of potential to ground = 89% above instantaneous maximum of normal wave.

Curve 2—E = Potential between lower leg of line and ground, 300:1 ratio potential transformer. Peak value of potential to ground = 75% above instantaneous maximum of normal wave.

Curve 3—E = Potential between middle leg of line and ground, 300:1 ratio potential transformer. Peak value of potential to ground = 45+% above instantaneous maximum of normal wave.



TEST "G."

Switching On Line No. 57604 by Closing Form K-10 Oil Switch at Station "M," Line Fused to Ground at Lincoln Substation.

Line energized from 60-Cycle System at Lincoln Substation.

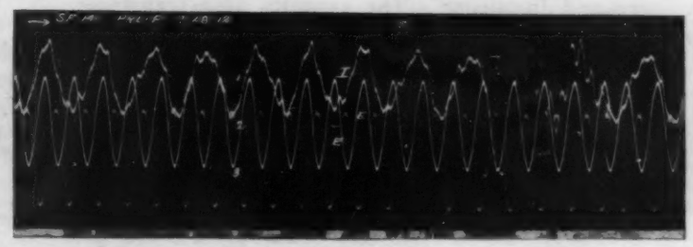
Observations made at Station "M."

Note: During this test transformer No. 3 was connected to line at Station "M." Neutral grounded through about 10 feet of No. 10 B. & S. gauge Climax resistance wire. Oscillograph vibrator used in Curve No. 1 was connected across resistance in ground connection of transformer neutral.

Curve 1—I = Current in neutral connection between transformer and ground (see note). Peak value of current in transformer neutral = 5 amperes approx.

Curve 2—E = Potential between middle leg of line and ground, 300:1 ratio potential transformer. No rise of potential to ground.

Curve 3—E = 57,000-volt sta. bus potential, 500:1 ratio potential transformer. No rise of bus potential.



TEST "H."

Charging Lightning Arresters on Line No. 57604 at Station "M."

Line energized by 60-cycle system at Knott Substation.

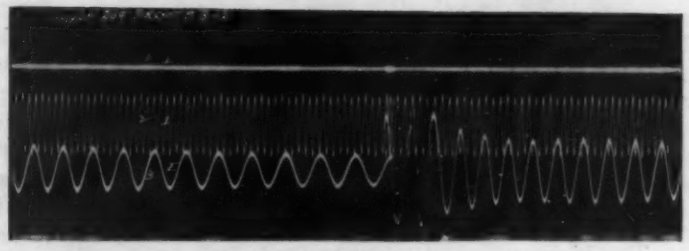
Observations made at Station "G."

Note: During this test, 60-cycle lighting load was connected to line No. 57602 at Tabor and Lents substations.

Curve 1—I = High tension line current = 0.

Curve 2—I = Current in neutral connection to ground of 3 — 1250 kw. Single-phase transformers energized from Station "G." No rise of neutral current.

Curve 3—E = Potential between one leg of line No. 57602 and ground, 300:1 ratio potential transformer. Curve No. 3 shows gradual decrease of voltage due to rotating machinery on line.



TEST "J."

Switching Off Line No. 57602 by Opening Form H-3, 57,000-Volt Oil Switch at Knott Substation. Line Open at Station "G."

Line energized from Station "M."

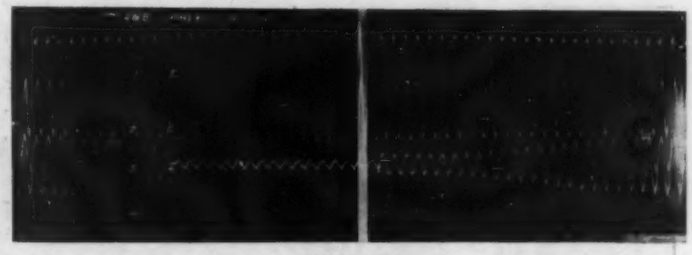
Observations made at Lincoln Substation.

Note: During this test, 60-cycle system at Knott Substation was connected to line No. 57602, energized from Station "G," and line No. 57604 through cable No. 11613, to Lincoln Substation.

Curve 1—E = Potential between upper leg of line No. 57604 and ground, 300:1 ratio potential transformer.

Curve 2—E = Potential between middle leg of line No. 57604 and ground, 300:1 ratio potential transformer. Normal potential to ground = 32,700 volts effective, taken from reading on voltmeter connected to potential transformer used in curve No. 2.

Curve 3—I = Current in one leg of cable No. 11613, 60:1 ratio current transformer. Peak value of current = 170 amperes approx.



TEST "P."

Opening Line No. 57604 With Townsend Air Break Switch at Lincoln Substation While Carrying 1000 Kw. Load.

and is shown to be a very pronounced eleventh harmonic superimposed upon a 60-cycle fundamental.

O. Switching off and on open line by air break switch.

These tests were made with a special type air break switch, designed by Mr. Townsend. The switch satisfactorily opened the line charging current a number of times, and the average results in voltage rise were approximately the same as obtained when switching with the Form K-10 switch. Since the switch is manually opened by turning a crank, the time of opening varies with the speed at which the crank is turned, taking over half a second in some instances.

P. Opening line with air break switch when carrying load.

Owing to the proximity of the line wires to the horn gaps, this test was not successful above 1000 kilowatts. This amount of load was successfully opened, however, without great voltage distortion.

The current on the low tension side of transformers feeding the transmission line during the period of opening line under load is shown in Record No. 268. The current gradually increases to maximum while the switch is opening, and gradually drops off until the circuit is opened, when the current shown represents transformer exciting current. This increase in current, no doubt, represents the current required to maintain synchronism between the two circuits during the opening of the switch.

Q. Time of closing switch contacts.

One of the 11,000-volt Form H-3 oil switches was tested with reference to the time of making or breaking contact on the three poles of the switch. When

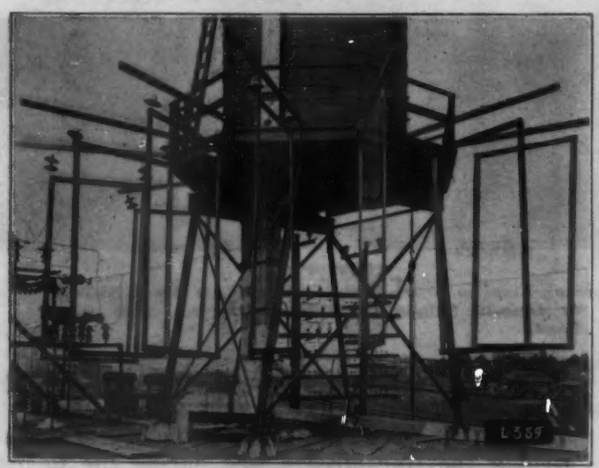
testing with 110 volts it was found that the contacts were not permanently made. The time elapsing between closing of first and last contact was found to be as great as one cycle. The switch was also tested with 11,000 volts, and the smaller wave shown is the charging current of condenser effect in potential transformer winding.

Natural period of transmission line.

The charging current of the transmission line was measured with a series ammeter and found to be approximately 6 amperes under normal conditions of voltage and frequency. The capacity of a transmission line as calculated from the charging current is C.279 m.f. The calculated inductance of the transmission line is 59.3 m.h. The natural period of the line, as calculated from these values, is approximately 1950 cycles per second, or 32½ times the fundamental. When one transformer is connected to the line, the natural period is reduced to approximately 1260 cycles per second. These frequencies are not much greater than the values commonly obtained in the test. No attempt has been made to calculate natural periods further than this, and with the system connected the calculations become complex. The presence of the 33-cycle parallel lines may have some effect upon the natural period of vibration. Another condition which has been suggested as a possibility in causing insulator failures is the presence near the transmission line at Lents Junction of a wireless station of considerable magnitude. This has not been investigated.

Conclusions.

The highest line voltage obtained during the entire series of tests represents approximately 180,000 volts instantaneous value, or 104,000 volts instantaneous value to ground. As the suspension insulators are tested at 90,000 to 100,000 volts per unit, it would seem that the tests did not reveal any justifiable cause for insulator failure, due to voltage rise caused by switching, charging arresters, or other operating conditions. The results, however, do indicate that a large factor of safety is required in the spacing of conductors in stations and substations, and in the results of apparatus connected directly or indirectly to the high tension lines. There are also certain conditions which have not become definitely defined under which low frequency surges may take place affecting the entire system. It is very clear, as has been pointed out before in other investigations, that it is much preferable to carry on switching operations on the low tension side of the transformers rather than with the high tension oil switches. Also, in connecting the line to the system by closing a low tension oil switch, only one transformer or bank of transformers should be used, if possible, in order to reduce the rush of transformer exciting current.



Tests of High Frequency Surges Apparatus Constructed at Portland to Test Pressure of Frequency Surges Higher Than Those on Oscillograph Records.

A full description of a similar series of tests and of the method of using the oscillograph for making these tests may be found in the proceedings of the A. I. E. E. for July, 1911, on Page 1621, in a paper by Mr. G. Faccioli.

PRESIDENT TAFT'S RECOMMENDATION ON WATER POWER.

There are pending before congress a large number of bills proposing to grant privileges of erecting dams for the purpose of creating water power in our navigable rivers. The pendency of these bills has brought out an important defect in the existing general dam act. That act does not in my opinion grant sufficient power to the federal government in dealing with the construction of such dams to exact protective conditions in the interest of navigation. It does not permit the federal government, as a condition of its permit, to require that a part of the value thus created shall be applied to the further general improvement and protection of the stream. I believe this to be one of the most important matters of internal improvement now confronting the government. Most of the navigable rivers of this country are comparatively long and shallow. In order that they may be made fully useful for navigation there has come into vogue a method of improvement known as canalization, or the slack-water method, which consists in building a series of dams and locks, each of which will create a long pool of deep navigable water. At each of these dams there is usually created also water power of commercial value. If the water power thus created can be made available for the further improvement of navigation in the stream, it is manifest that the improvement will be much more quickly effected on the one hand, and, on the other, that the burden on the general taxpayers of the country will be very much reduced.

In my opinion constructive statesmanship requires that legislation should be enacted which will permit the development of navigation in these great rivers to go hand in hand with the utilization of this by-product of water power, created in the course of the same improvement, and that the general dam act should be so amended as to make this possible. I deem it highly important that the nation should adopt a consistent and harmonious treatment of these water power projects, which will preserve for this purpose their value to the government, whose right it is to grant the permit. Any other policy is equivalent to throwing a a most valuable national asset.

ELECTRICAL PUMPING AND IRRIGATION

DEPTH OF CUT FOR CANALS IN LEVEL GROUND.

BY B. A. ETCHEVERRY.

Conveyance Losses of Water in Canals.

All irrigators are well acquainted with the fact that the losses in conveying water in earth canals are in many cases very large and with newly excavated canals are often so great that it is difficult to deliver water at the lower end. On irrigation systems with unlined canals, these losses usually range from 25 to 60 per cent of the water diverted or taken in the canal systems, and there are many instances where the losses are much greater. On some California canals losses of 64 per cent per mile have been observed. It is safe to state that on an irrigation system consisting of earth ditches only 50 per cent of the water diverted is delivered to the fields.

The water lost by seepage disappears through some underground drainage channel or raises the water table of the lands adjacent to and below the canal. This causes the waterlogging of the land or accumulation of alkali salts on the surface. This effect, combined with wasteful irrigation, has been the cause of over ten per cent of the irrigated lands of the West becoming unfit for crop production. On one project in eastern Washington after only the first irrigation season considerable land was waterlogged and in some portions the water table had risen sufficiently to cover the land several feet deep. These damages alone, in many cases, justify the expense of lining the canals. But even if injury by waterlogging is not considered, there are many localities where the water is sufficiently valuable to make the lining of canals to stop the loss of water, a paying proposition. The amount of money which one is justified in spending will be in proportion to the extent of the losses.

1. Extent of Seepage Losses in Canals.

The extent of seepage losses depends on many factors, such as porosity of the soil, the form of cross-section, the size of the canal, the number of seasons the canal has been operated, the amount of silt in the water, the velocity of flow, the depth to the water table, etc. The most valuable general observations as regards the amount of these losses are those of the Irrigation Investigations Office of the United States Department of Agriculture. From series of measurements on seventy-three ditches in the Western States they have found that the average loss per mile of ditch is 5.77 per cent of the entire flow; the measurements range from a maximum of 64 per cent per mile to a slight gain in a few cases. Large canals in general lose less in proportion than small ones. The measurements show that the loss per mile averages about 1 per cent for canals carrying 100 cubic feet per second or more, about 2½ per cent for canals carrying 50 to 100 cubic feet per second, 4½ per cent for canals carrying 25 to 50 cubic feet per second, and 11¼ per cent for canals carrying less than 25 cubic feet per second.

For some purposes it is preferable to know the extent of seepage expressed in cubic feet of water per day per square foot of wetted area of the canal. This is equivalent to stating the depth of water in feet lost each day. A number of measurements have been made in various parts of the country, and some of these have been assembled by F. W. Hanna, project engineer of Boise Project, United States Reclamation Service in Idaho, who states that from careful consideration of the data assembled it would appear that a seepage loss of 0.5, 1 and 1.5 cubic feet per square foot of wetted surface per day might be assumed for canal losses respectively for rather impervious, mediumly impervious and rather pervious soils. Based on the above figures and for canal cross-sections generally used for laterals in earth, he has obtained the values given below for the seepage loss per mile, expressed in per cent of flow. The form of the cross-section is based on the following assumptions: (1) Relation of bottom width of canal; (b) to depth; (d) is $b = 1.5d^2 + 1.5$, and not less than 3 ft.; (2) Side slopes, 2 to 1; (3) mean velocity is equal to 2 ft. per second.

Dimensions of Canal.					Seepage Losses.			
					Sec. ft.	Per cent lost per mile.		
Depth.	Bottom width.	Area.	Wetted perimeter.	Capacity.	per mile for S=1.	for S=0.5.	for S=1.0.	for S=1.5.
0.5	3	2	5.24	4	0.31	4.0	8.0	12.0
1.0	3	5	7.48	10	0.45	2.3	4.5	6.8
1.5	5	12	11.72	24	0.70	1.5	2.9	4.4
2.0	8	24	16.96	48	1.02	1.0	2.1	3.1
2.5	11	40	22.20	80	1.33	0.8	1.7	2.5
3.0	15	63	28.44	126	1.71	0.7	1.4	2.1

S = rate of seepage in cubic feet per square foot of wetted surface per day = 0.5 for rather impervious soil, 1.0 for mediumly impervious, and 1.5 for rather pervious soils. From the above computations Mr. Hanna has prepared the following table of general values for designing irrigation laterals.

Seepage Values for Designing Irrigation Laterals.

Capacity of Canal.	Loss in per cent of flow per mile.		
Cu. ft. per second.	For rather impervious soil.	Mediumly pervious soil.	Rather pervious soil.
10 or less	4	8	12
11 to 25	2.5	4.5	7
26 to 50	1.5	3.	4.5
51 to 75	1.	2.	3.
76 to 100	.75	1.5	2.5

The above table gives results which agree with those obtained by the Irrigation Investigations Office as closely as can be expected because of the numerous factors involved.

2. Evaporation Loss from Water Surface of Canals.

The losses above stated include seepage and evaporation, but, contrary to the general belief, the losses of evaporation from flowing water in a canal are insignificant compared with those of seepage. It has been shown that the losses of seepage and evaporation per day might be assumed at 0.5, 1 and 1.5 cubic feet of water per square foot of wetted surface, respectively, for rather impervious, mediumly impervious and rather pervious soil. These are equivalent to losses of water 6, 12 and 18 inches deep. As compared to these figures, the evaporation from water surface for the irrigation season will generally be

about one-quarter of an inch per day, which is from 25 to 75 times less than the above seepage losses. Seepage and evaporation measurements made at Twin Falls, Idaho, and reported by Elias Nelson (Bulletin 58, University of Idaho) show that the evaporation ranged from less than 1 per cent to less than 2 per cent of the total loss in the canals. On one of the largest systems in the San Joaquin Valley, California, the total length of canals is 165 miles, and the total seepage loss was 28 per cent, and 30 times greater than the evaporation loss. These and other numerous experiments show that the evaporation losses in the conveyance of water are so small as compared with the seepage losses that they are of no importance.

Prevention of Seepage Losses in Canals.

To prevent the loss of water in conveyance, lining the canals with different materials has been tried. Those used or experimented with are concrete, wood, asphalt, oils, and clay puddle. A good lining should fulfill the following requirements: It should be watertight, prevent the growth of weeds, stop burrowing animals, be strong and durable, and preferably not

Lining Plastered Without Forms, Gage Canal, Riverside, California.

affected by the tramping of cattle. From investigations made by the writer in 1906, and from more recent experience as regards the efficiency of the different types of linings, the following results can be anticipated:

First—A good oil lining, constructed with heavy asphalt road oil, applied on the ditch sides and bed at the rate of about three gallons per square yard, will stop 50 to 60 per cent of the seepage.

Second—A well-constructed clay puddle lining is as efficient as a good oil lining.

Third—A thin cement mortar lining about one inch thick, made of one part cement to four of sand, will prevent 75 per cent of the seepage.

Fourth—A first-class concrete lining, three inches thick, made of one part of cement to two of sand and four of gravel, will stop 95 per cent of the seepage.

Fifth—A wooden lining, when new, is as efficient as a concrete lining, but after two of three years repairs and maintenance will become an important item, and by the end of eight or ten years it will necessitate complete renewal.

The cost of an oil lining, where oil can be bought at California prices (about 2 cents a gallon) is about ½ cent per square foot. Cement mortar lining one inch thick costs about 3 to 4 cents per square foot. Cement concrete two inches thick costs about 6 to 8 cents, and three inches thick about 8 to 10 cents a square foot. These prices do not include the trimming and preparation of the ditch before the lining is put on, which would add from ¾ to 1½ cents per square foot. The cost of a clay lining depends greatly on the nearness of the canal to suitable clay. If clay is close at hand, it can be hauled and spread on the canal, then either tramped in by cattle or worked in by dragging chains over it, at a cost of less than 1 cent per square foot, but there are localities where money enough has been spent on clay linings to pay for a good concrete lining. Wooden lining has been used in very few cases, and the cost of such a lining, built of 2-inch lumber nailed on sills and side yokes, will not be less than that of a 2-inch concrete lining, and it will not be nearly as durable.

The disadvantages of the cheaper linings are the following: An oil lining stops only a part of the seepage losses, and while it will resist erosion well, it probably will not prevent the growth of weeds for more than one season unless a high velocity is used, and it will not stop the activities of burrowing animals. Oil linings have not been sufficiently tested to determine their durability.

Clay puddle will not prevent the burrowing of animals, and weeds grow rapidly, especially since the velocity of the water must be small in order to prevent the eroding or washing of the lining.

A concrete lining has none of the above disadvantages, and it meets the requirements of a good lining better than any other material. The only objection is its higher first cost. This, however, can be partly balanced, especially on side hill work, where a new canal is to be constructed by using a higher velocity and a smaller cross-section, thus decreasing the cost of excavation. Where an old canal must have its capacity enlarged, this may be done either by lining the canal, which will give a higher velocity because of the smoothness of the channel, or by increasing the cross-section by excavation. The cost of extra excavation, especially on side hills through hard material, may be greater than the cost of lining.

Concrete lining will in many cases prove to be the most economical type of lining. However, where good clay is available, and where it is not financially feasible to use concrete, clay puddle may be used to advantage in improving leaky earth canals when the velocity of flow is under three feet per second.

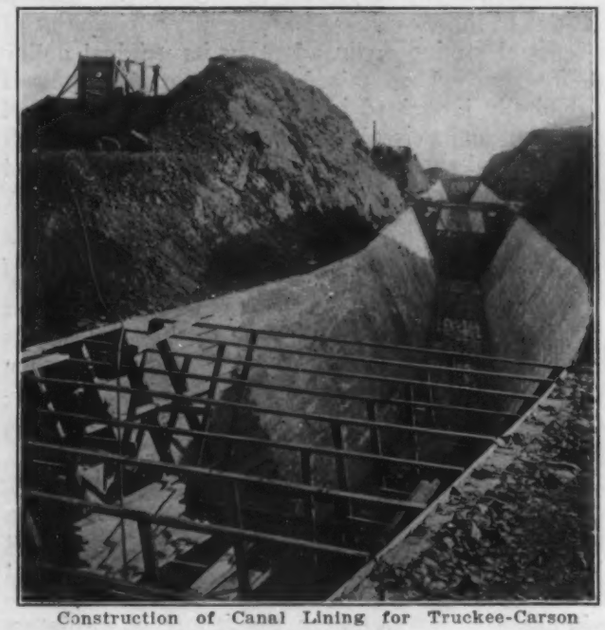
1. Concrete Linings.

The earliest use of concrete linings was in Southern California, about 1880, when the increasing value of water made it necessary to do away with losses. Since that time practically all of their canals, which are comparatively small, carrying less than 100 cubic feet per second, have been lined with concrete, and in some cases replaced with concrete pipes. Until recently very little concrete lining had been done outside of that region, but during the last few years concrete-lined canals have been constructed on many of the projects of the United States Reclamation Service

and on numerous private projects. There are now several examples in California, Oregon, Nevada, Washington, Idaho and other states, and during the past two years some excellent work has been done in British Columbia.

Form of Cross-Section and Thickness of Lining.

Unlined canals in earth are usually constructed broad and shallow, with the side slopes varying according to the character of the soil. This may be as steep as ½ horizontal to 1 vertical for hardpan or very firm soil, or as flat as 2 to 3 horizontal to 1 vertical for loose sandy soil. For a lined canal it is more economical to use a comparatively narrow deep section and fairly steep side slopes. This reduces the excavation and the amount of concrete. The side slopes must not be much steeper than the slope on which the ground will stand, or else the earth pressure, which has a tendency to push the side in, must be considered and the side lining designed as a sloping retaining wall. The slope of the sides and the thickness of the



Construction of Canal Lining for Truckee-Carson Project, Nevada.

lining are therefore related and depend on the depth of the canal, the character of the method of construction and permanency. Generally the flatter the side slopes the thinner can the lining be made. When the lining is placed on the natural slope of the ground, as it resists no earth pressure, it can be made very thin, and in Southern California fairly satisfactory results have been obtaind on many systems with linings on inch or less in thickness. One example of very thin linings where there are low winter temperatures is a canal near Hanford, in Eastern Washington, which is lined for four miles with a concrete lining from ½ to 1½ in. thick. The lining was rather badly cracked, but this was largely due to poor workmanship. It was sufficiently efficient, however, to carry water over this length of the canal without appreciable loss, which was impossible before its construction. But even where the conditions are as favorable as in Southern California, a thickness of 1½ in. should be used as a minimum, and preferably 2 or 3 in. Linings 1 to 3 in. thick have been entirely satisfactory in Eastern Oregon, Eastern Washington and British Columbia, where the temperature has been as low as 20° and 30° below zero. Where the side slopes of the lined section are to be made steeper than the natural slope of the earth, the thickness should be sufficient to resist the earth thrust. To compute this the following formulae for normal earth pressure against the side lining, and known as Coulomb's Formulae, are reproduced.

First—For earth pressure with no surcharge—

$$P = \frac{1}{2} wh^2 \frac{\sin^2 \frac{1}{2}(\theta - \phi)}{\sin\theta \sin^2 \frac{1}{2}(\theta + \phi)}$$

Second—For earth pressure with maximum surcharge—

$$P = \frac{1}{2} wh^2 \frac{\sin^2(\theta - \phi)}{\sin^2\theta}$$

In both these equations P = normal earth pressure; w = weight of earth in pounds per cubic foot; h = vertical height of the side lining; θ is the slope angle made between the side wall and the horizontal ϕ = natural angle of slope of the earth. The overturning moment P is equal to P multiplied by its lever arm, which is equal to one-third the length of the side lining measured on the slope. This overturning moment must be balanced by the moment of the weight of the side lining. The following thicknesses of concrete linings are safe, according to the above formulae, and agree with good practice.

Thickness of lining in inches.	Side slope of canal.	Natural slope of repose of earth.	Maximum depth of Canal. With maximum surcharge.	Maximum depth of Canal. With no surcharge.
3	½ to 1	1 to 1	4.5	14.0
3	½ to 1	2 to 1	1.0	2.75
3	1 to 1	2 to 1	4.0	8.5
3	1 to 1	3 to 1	1.75	4.0
2	½ to 1	1 to 1	3.0	9.50
2	1 to 1	2 to 1	2.75	5.50
2	1 to 1	3 to 1	1.25	2.75

Shrinkage and Expansion.

No matter what the thickness is, unless the concrete is reinforced with steel, or expansion joint provided, cracks are to be expected, because of the contraction or shrinkage in winter. These cracks will usually be fine cracks, occurring at more or less regular intervals, and the leakage through them will be small, and often they probably silt up. For better appearance and to distribute the cracks at uniform intervals, the lining should be laid in sections or strips 6 to 8 ft. long.

Effect of Frost.

Frost should have no effect on the lining if the soil is well drained. But when the soil contains water, freezing will produce heaving of the soil, which will not be resisted even by thicker linings than those recommended. Usually a canal which must be lined is located where the water drains too readily from the soil, but if the canal is located where water is liable to collect behind the lining, a drain should be provided. The drain should be a 3 or 4-in. tile placed below the floor of the canal lining in a trench 12 in. deep, located along the center line of the canal, and the tile covered preferably with loose rock, gravel, sand, or other porous material. To discharge the water collected, cross drains should be placed every 400 or 500 feet, or wherever there is a drainage channel.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

Technical Publishing Company

Rialto Building, San Francisco

E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBERT SIBLEY, Treasurer and Editor in Chief
C. L. CORY, Secretary and Special Contributor
A. M. HUNT, Director and Special Contributor

On Library Cars of all Southern Pacific Trains.

TERMS OF SUBSCRIPTION

United States, Cuba and Mexico	per year,	$2.50
Dominion of Canada	"	3.50
Other Foreign Countries within the Postal Union	"	5.00
Single Copies, Current Month	each	.25

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

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Distributing Electrical Apparatus

Thirty years ago there was but two factors in the electrical business, the manufacturer and the central station, the latter having been invented and promoted by the former. There were no dealers, jobbers or contractors. The central stations wired the houses and sold the lamps, no other current-consuming devices then being made. A single channel sufficed to carry the goods from the maker directly to the user.

Later there came a great flood of electrical appliances. New channels of trade were suddenly opened and the electrical contractor, jobber and dealer became an integral part of the great distribution system. They were necessary to carry on the surplus business which is still rapidly increasing. The central station gladly relinquished the actual sale and installation of apparatus in the thought that its selling energies could best be devoted to furthering the use of electric power.

Because of the perplexing problems of the mutual relations of these various interests, the advisability of the central station again adopting its original policy has frequently been raised. The central station is most vitally interested in the grade and character of devices put on its circuits and naturally wishes to maintain a general supervision. Where the contractors and dealers are willing to co-operate with the company little trouble is experienced, and in other cases a liberal education seems necessary.

No improper motives must be ascribed to any of the parties involved. As the engineer dams a great river, leads off its waters through ditches and flumes to the places most needed, so are the farseeing men of the electrical industry patiently and carefully striving to divert the proper distribution of electrical goods through the national channels.

High Tension Switches

The Portland Railway, Light & Power Company's steel tower transmission line representing the latest word in design, has, during recent months, experienced some difficulties from the failure of insulators of the suspension type. Oscillograph investigations have proven that the failure does not result from undue surges in the opening and closing of the high tension and low tension lines, the charging of lightning arresters, or other operating conditions. Though these investigations have proven fruitless in this regard, yet interesting subsidiary deductions may be drawn.

In the course of these tests it was found that the effect upon the voltage conditions is most pronounced at the station or system to which it has been or will be connected. Indeed, in some cases the voltage rise exceeded that on the transmission line itself. Hence, it is imperative that a large factor of safety be allowed in the spacing of conductors in stations and substations.

From the data collected in these tests emphasis is again laid upon the importance of carrying on the switching operations on the low tension side of the transformers rather than with the high tension oil switches. Caution should also be observed in con-

necting the line to the system when closing a low tension oil switch by using only one transformer or bank of transformers in order to reduce the rush of transformer exciting current.

The data gathered in this test relative to telephone lines, in view of the investigation by the power and telephone companies now under way in California, is also interesting. During this particular test, one leg of the telephone line was grounded on the line side of the insulating transformer. The oscillograph record thus taken indicates a pronounced eleventh harmonic superimposed upon a 60 cycle fundamental. At Morgan Hill, in California, the Bell Telephone Company is taking data upon the Coast Counties Gas & Electric Company's transmission line. The Sierra & San Francisco lines are now under construction at this point. It will be interesting to note the combined effect of two high tension transmission lines operating at different voltages and slightly differing frequencies.

Fundamental Principles of the Diesel Engine

Rumors of the near initial bow of Diesel engine operation on the coast are rife on all sides. The early arrival is certain; for, as in the foretelling of the coming of the Mesiah, "we have seen his star in the East." Yet the fact remains that, as perfect as are the thermodynamic principles upon which the Diesel engine is based and, as glowing as are authentic accounts of European and Eastern practice today, nevertheless, not a single Western installation can vaunt the hand of victory to the rows of doubting Thomases.

During the past fortnight a noted expert has turned down the proposed Diesel engine installation at the Alameda municipal plant situated at Alameda, California. Until the proponents of Diesel practice can come out in the open and actually show to the cautious engineer the throbbing engine in operation, until he can exhibit the cost sheets, the economy curves and the like taken from operation by California oils such conservatism must be expected.

The thermodynamic principles upon which the Diesel engine operates are interesting. In the ordinary gas engine, a mixture of air and gas is drawn in from without and then compressed. At the completion of compression, a spark causes the gaseous mixture, thus compressed, to ignite. The enormous heat given out by combustion, immediately raises the resulting gases to a high temperature. In the elementary study of gases and their thermodynamic behavior we learn that when heat is added and the volume cannot be increased, there results an increase in pressure proportional to the increase in absolute temperature of the gas. Hence, although this gaseous mixture has been previously compressed, yet it is now raised to a still higher temperature and pressure. As in the recoil of a highly compressed spring, this energy reservoir of compressed gases now supplies the heat necessary to perform the return stroke, in which the piston head is pushed forward, thus driving the engine mechanism.

In the Diesel operation the principle is considerably different. Instead of compressing a mixture of air and gas, only the air itself is compressed. Compression, however, is much more complete. So much so, in fact, that the temperature of the air is raised higher than the flash point of the particular oil fuel to be used. It is evident, too, that when oil is now sprayed into this heated air mixture, ignition will take place without the use of a spark. Hence, under the Diesel principle, it is not necessary to instantaneously explode the entire charge, but if the oil is properly sprayed in, the combustion may be made to extend over a portion of the return stroke, in such a manner that an isothermal relationship, or equal-temperature of the gas content, is maintained until combustion is complete.

Years ago, Carnot announced the principle that the motive power of heat is independent of the agents employed. Indeed, it is determined solely by the temperatures of the bodies between which the cyclic transfers of heat occur. The Carnot cycle, in which the gas expands isothermally for a portion of the stroke completing its expansion adiabatically or without heat being added or taken from the gas during the latter portion of stroke, can be shown to be the most perfect ever to be anticipated. In this cycle the gas is brought back to its original state in the engine cylinder by similar compressive laws. The Diesel cycle differs in the return stroke only. For instance, instead of being compressed isothermally and then adiabatically, the mixture exhausts under constant volume and is then compressed adiabatically.

In actual practical operation the Diesel engine uses a considerable quantity of excess air. The pressure along the combustion line is from 450 to 600 lb. per sq. in. The pressure at which the oil is delivered is 750 lb. per sq. in. and the temperature at the end of compression approaches 1000 degrees F. There is no uncertainty as to the time of ignition; it begins immediately upon the entrance of the oil into the cylinder. To avoid pre-ignition in the supply tank, the high-pressure air used to inject the oil must be cooled. Thermodynamically, the engine operates more efficiently on light loads than heavy and its cycle of operations is, on the whole, more efficient than the usual gas engine cycle.

The field of usefulness for this threatening giant in the power field is far-reaching. Sane and sound judgment, however, demands that we withhold final decision as to Western applications until California oils of usual gravity range can be shown to successfully and economically drive this mechanism.

Amendment No. 34

The defeating of Amendment No. 34 at the recent San Francisco polls is truly to be regretted. Here is a city which has employed the ablest counsel in framing a progressive franchise policy, and yet in face of its findings and advice, turns down this mature and highly scientific enabling clause as proposed. The passing of the civic center enactments and other propositions relative to the Panama-Pacific Exposition are the only happy thoughts arising from serious reflection concerning the vote of last Tuesday.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

G. I. Kinney, Pacific Coast manager of the Fort Wayne Electric Works, is at Los Angeles.

Sidney Sprout, consulting electrical engineer at San Francisco, spent the past week at the properties of the California Oregon Power Company.

Frank J. Quinn has opened offices in the Atlas Building, San Francisco, as Pacific Coast representative of the Manhattan Electric Supply Company.

W. F. Neiman, general sales manager for the Great Western Power Company, has also assumed the duties of manager of the City Electric Company of San Francisco.

L. H. Newbert, manager of appliance department of the Pacific Gas & Electric Company, is expected to return from the convention of the National Commercial Gas Association, this week.

F. E. Geibel has taken his former position in the electrical engineering department of the Southern Pacific Company at San Francisco after two years' absence spent at his home in Alabama.

George Scarfe, superintendent of the Nevada City power division of the Pacific Gas & Electric Company, presented a paper before the California Miners' Association convention at San Francisco this week.

W. L. Locke, engineer with the Stone & Webster Construction Company in charge of transmission line construction for the Big Creek plant of the Pacific Light & Power Company, was at San Francisco this week.

Tsunetaro Kujirai, assistant professor of electrical engineering at the Imperial University at Tokyo, was a recent interested visitor at the electrical departments of Stanford University and the University of California.

George S. Johnson, formerly a designing engineer with the Great Western Power Company in charge of substation design of its northwestern division, is now design assistant to S. Barford, engineer of the Oro Electric Corporation.

W. D. A. Ryan, illuminating engineer with the General Electric Company, gave a talk on the proposed plans for the illumination of the Panama-Pacific Exposition on December 11, before the San Francisco members of the American Institute of Electrical Engineers and the Electrical Development League.

Kempster B. Miller has been at Bend, Oregon, in connection with the purchase of the control of the Bend Water, Light & Power Company by McMeen & Miller of Chicago and their associates. It is understood that J. P. Keyes, who has had charge of the hydroelectric plant on Deschutes River, will continue in that capacity. Plans are being prepared to enlarge the electric and the water plants.

Sidney R. Inch, at present general manager of the Missoula Light & Water Company, will, beginning with January first, assume the duties of general superintendent of the recently formed Utah Power & Light Company at Salt Lake City. This company is a consolidation of a number of companies operating in Utah, Idaho and Colorado, the most important of which is the Telluride Power Company. The combined properties have about 1000 miles of high tension transmission lines, a plant capacity of over 100,000 h.p. and have water power resources for the development of as much again. As recently announced in the press, the Denver & Rio Grande Railroad is going to electrify its mountain section. The Utah Power & Light Company will furnish the power for it.

MEETING NOTICES.

Oregon Jovians.

In connection with the convention of the Oregon Electrical Contractors at Portland, December 17-19, a Jovian rejuvenation will be held at the Multnomah Hotel on December 19. A supper was recently served at the Bowers Hotel to about fifty Portland electrical men when arrangements were started for this rejuvenation, the third this year. George R. Sailor of the Westinghouse Electric & Manufacturing Company, is Statesman and J. E. Davidson of the Pacific Power & Light Company alternate.

Electrical Development League.

The second semi-annual meeting of the Electrical Development League of San Francisco was held December 10th. The election of officers for the ensuing six months' term resulted in the selection of T. E. Bibbins as president; C. C. Hillis, vice-president, E. B. Strong, secretary-treasurer. Members of the executive committee also elected were W. L. Goodwin and P. C. Butte. Mr. Bibbins in addressing the meeting on his election to the presidency of the organization made an earnest plea for the more active participation and interest on the part of the central stations as well as the manufacturers and contractors in the affairs and welfare of the League.

Pacific Northwest Society of Engineers.

Plans have been made for the annual dinner and meeting of the Pacific Northwest Society of Engineers, at the New Washington Hotel, Seattle, Saturday evening, January 4, at 7 o'clock. The annual election will be conducted by mail. Two or more candidates have been nominated for most of the important offices. C. W. Harris, assistant professor of engineering at the University of Washington, read a paper on "Determining the Diameter of Pipe Lines, the Theory and Method of Application," at the last meeting.

Portland Section A. I. E. E.

The next regular meeting of the Portland Section of the A. I. E. E. will be held on December 17, 1912, in the assembly hall, Electric Building. The speaker will be Mr. L. D. Gilbert, Cement Engineering Company, on the subject of "Electricity as a factor in the development of the Cement Industry."

The Portland Section of the A. I. E. E. have written to all the other Pacific Coast Sections, suggesting that the Sections of the Coast get together and nominate a prominent Pacific Coast member for the office of vice-president.

Portland Engineers and Architectural Club.

The joint luncheon of the Engineers and Architectural Clubs of Portland was held at noon Tuesday, the 3d, at the Portland Hotel. The chairman being Mr. A. S. Moody, and the speaker Hon. E. E. S. Wood on the "Employers' Liability Law of Oregon." The unanimous vote of 110 members was received on the subject of the consolidation of the Oregon Society of Engineers and the Portland Architectural Club as regards headquarters.

Los Angeles Section A. I. E. E.

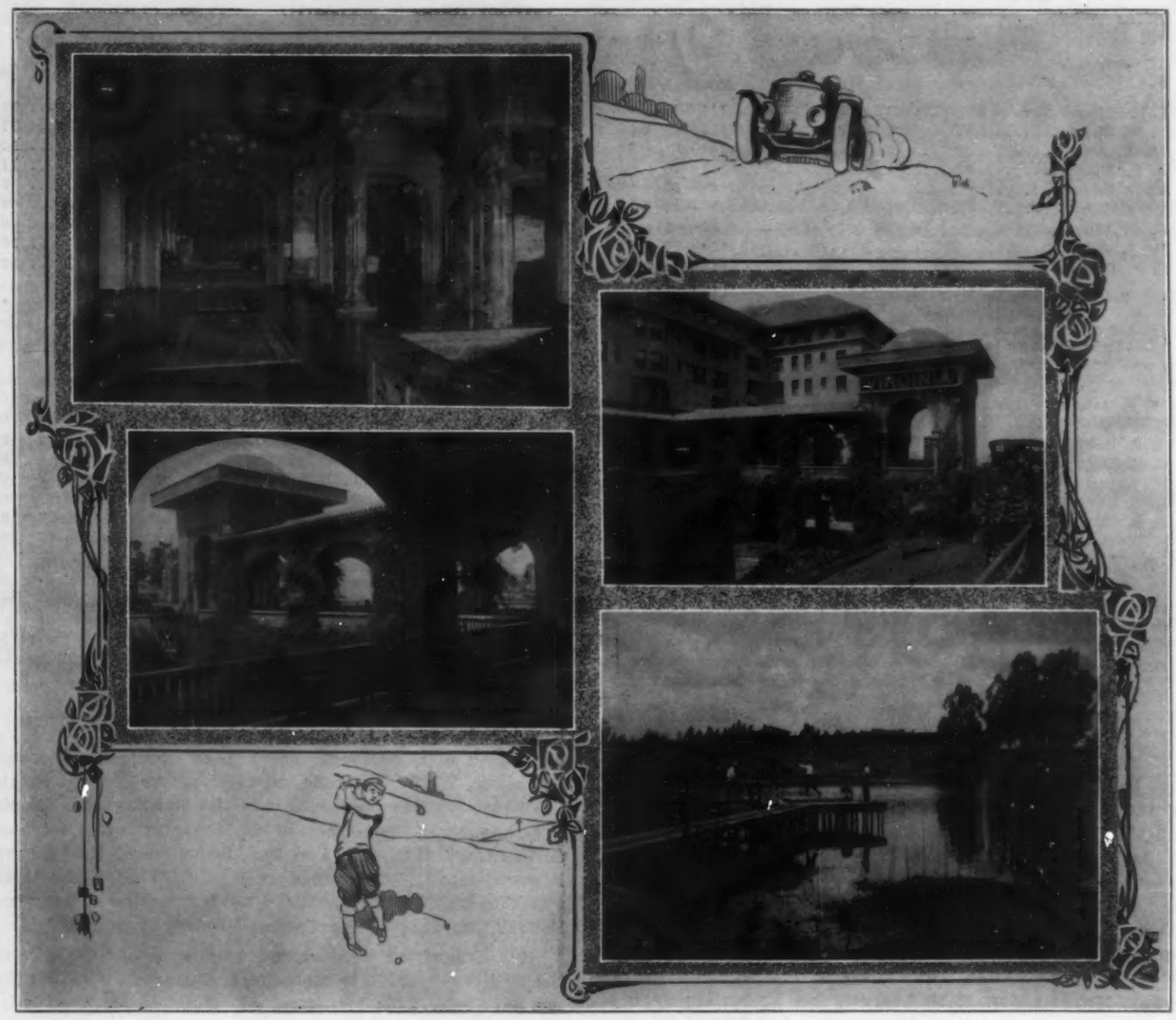
The Los Angeles Section of the American Institute of Electrical Engineers held its regular monthly meeting at Blanchard Hall, on Tuesday evening, November 26, 1912. There were present 40 members and visitors. President George A. Damon was in the chair. Before the paper of the evening, Prof. R. W. Sorenson, chairman of the program committee, announced W. D. A. Ryan of Schenectady, New York, could not be present, but he hoped to have him present to give his talk on "Illumination" for the next meeting. Mr. Damon then introduced F. W. Harris, who read a paper entitled "Oil Switches and Circuit Breakers." This proved a very interestng subject and brought forth much discussion by the following: E. W. Paul, J. E. Macdonald, C. A. Howell, Ed. Woodbury, R. W. Sorenson, D. D. Morgan, A. W. Nye. The meeting then adjourned.

ELECTRICAL JOBBERS' MEETING.

The Pacific Coast Electrical Jobbers' Association met in regular quarterly convention in Southern California during the week of December 7th. The program was slated for the Hotel Avalon, Catalina Island, but whether it was the weather man or the genial secretary and chairman of entertainment, Albert H. Elliott, who designed the most unique pre-convention entertainment, had not been decided when the meeting adjourned.

A Santa Ana sand storm, which Southern California claims occurs not oftener than once in five years, met the electrical jobbers, their guests the manufacturers, the ladies and one other. Never to mortal man or woman was a more welcome sight presented than that of the still waters of the harbor at sunset that evening.

We were too empty for utterance. Packed in a car already packed, we were silently taken to Long Beach. The ambulance corps, consisting of the bellboys of the Hotel Virginia, soon had the baggage in the rooms and a great transformation scene was about to be enacted. Bedraggled, begruntled, begrimed, and I might say be ————, we entered the dining room. The beautiful picture brought smiles to the faces



Pleasant Recollections of Long Beach.

visitors from the north and accompanied them across the channel. After three unsuccessful attempts to land at Catalina Island, the little steamer was headed back to the mainland, through the tossing, torturing waters. As one of the principal events planned for the meeting was to be a fishing contest, the irony of the situation was apparent while the fish were being fed. All had failed to bolt their breakfast.

As in all emergencies, the really great men spring to the front from most unexpected quarters, "Grandpa" Carter, the colonel of the regiment, flashed a few aerograms to the Hotel Virginia, asking that ambulances and provisions be provided for forty. The one word in answer, "sure" was sufficient.

If Los Angeles should ever need "boosters" for the beautiful harbor of San Pedro, they will but have to refer to the of all when the "me an' u" had been devoured with the rest of the good things that the pretty girls brought to us, there was not one that could remember that there had ever been a Santa Ana sand storm.

A meeting was immediately called to arrange the program. The good people of Long Beach came to the rescue with open arms. A most cordial invitation was extended to the visitors by the Virginia Country Club. This was accepted with a vote of thanks. Not only did they extend the true southern hospitality of presenting the links to the visitors in fee simple, but every member owning an automobile appointed himself as chairman of the entertainment committee, and saw that their guests were provided with cars at a moment's notice.

The Hotel Virginia can be congratulated upon its able

management and also on each individual employe. But what's the use of praise; we met in Southern California. Two joint meetings of the jobbers and manufacturers were held during which many happy thoughts were suggested, and a spirit of co-operation was established that cannot help but be of inestimable value to all.

These pleasant outings are today recognized as one of the most important factors by all business concerns.

The banquet Saturday evening, and the dance that followed, closed one of the most successful and largest meetings ever held on the Pacific Coast. The pool tournament was won by Miles Steel, and the golf tournament was as follows:

Friday, December 6, 1912.

Jobbers Eligible Only.

Ever Ready Cup.

	Gross	Handicap.	Net.
C. B. Hall	111	—16	95
N. W. Graham	117	—22	95
†F. N. Averill	106	—27	79
A. H. Elliott	117	—16	101
F. H. Leggett	99	—13	86
W. S. Berry	97	— 1	96
C. C. Hillis	91	— 5	86
H. V. Carter	100	—13	87
C. R. Dedrick	121	—23	98

Seaver Cup.

C. B. Hall	111
N. W. Graham	117
N. F. Averill	106
A. H. Elliott	117
F. H. Leggett	99
W. S. Berry	97
‡C. C. Hillis	91
H. V. Carter	100
C. R. Dedrick	121

Saturday, December 7, 1912.

*Electrical Contractors' Association Cup. To be played for 10 times (1st time)

	Gross	Handicap.	Net.
†F. N. Averell	98	—23	75
N. W. Graham	121	—12	109
C. R. Dedrick	130	—13	117
C. C. Hillis	92	+ 7	99
H. V. Carter	94	— 3	91
W. S. Berry	99	+13	112
C. B. Hall	110	— 8	102
F. H. Leggett	107	— 7	100

Jobbers' Perpetual Cup.

	Gross	Handicap.	Net.
†F. N. Averell	98	—23	75
N. W. Graham	121	—12	109
C. R. Dedrick	130	—13	117
C. C. Hillis	92	+ 7	99
H. V. Carter	94	— 3	91
W. S. Berry	99	+13	112
C. B. Hall	110	— 8	102
F. H. Leggett	107	— 7	100

(8 time win.) Patten Cup.

	Gross	Handicap.	Net.
†F. N. Averell	98	—23	75
N. W. Graham	121	—12	109
C. R. Dedrick	130	—13	117
C. C. Hillis	92	+ 7	99
H. V. Carter	94	— 3	91
W. S. Berry	99	+13	112
C. B. Hall	110	— 8	102
F. H. Leggett	107	— 7	100

(8 time win.) Manufacturers' Cup.

	Gross	Handicap.	Net.
M. F. Steel	115	—15	100
F. H. Poss	118	—13	105
R. B. Clapp	107	—12	95
T. E. Bibbins	95	— 4	91
H. E. Sanderson	89	+ 7	96
†Garnett Young	112	—27	85
W. B. Hall	128	—27	101
J. A. Herr	150	—27	123

*The Pacific Coast Division of the National Electrical Supply Jobbers' Association:

Gentlemen: On behalf of the National State Association of Electrical Contractors, I take pleasure in handing you herewith a trophy, to be played for at the golf tournaments of your regular Pacific Coast meetings. The cup is to be the permanent property of anyone winning the same three times.

The rules as to what constitutes a win are contained in nine (9) sealed and numbered envelopes attached herewith. These envelopes are to be opened in their numerical order—one after each tournament has been played.

Trusting that you will find it interesting to have one more trophy for your golf competition, I remain,

Yours truly,

J. C. RENDLER, President.

†Winner.
‡Winner outright.

Those in attendance were:

F. N. Averill, Portland; Mr. and Mrs. W. S. Berry, San Francisco; T. E. Bibbins, San Francisco; F. E. Burger, Los Angeles; H. V. Carter, San Francisco; R. J. Davis, San Francisco; C. P. Dedrick, Portland; Albert H. Elliott, San Francisco; Frank Fowden, San Francisco; C. L. Gilson, Oakland; M. A. Graham, Los Angeles; S. B. Gregory, San Francisco; C. B. Hall, Los Angeles; Mr. and Mrs. Brewster Hall, San Francisco; Jas. H. Herr, San Francisco; C. C. Hillis, San Francisco; P. J. Hyde, San Francisco; Mr. and Mrs. F. H. Leggett, San Francisco; John M. Morris, Los Angeles; F. H. Murray, Los Angeles; F. W. Poss, San Francisco; H. E. Sanderson, San Francisco; Mr. and Mrs. H. B. Squires, San Francisco; Miles F. Steel, San Francisco; E. B. Strong of the Journal of Electricity; C. E. Wiggins, San Francisco; Garnett Young, San Francisco.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

December 5.

A decision was rendered granting permission to the Ojai Power Company to issue $25,000 of stock for the construction of an electric light plant in Nordhoff, Ventura County. The company was also granted a certificate of public convenience and necessity to exercise franchise rights.

The application of the Coalinga Water & Electric Power Company for an order authorizing the expenditure of funds secured from bond sales was dismissed upon the request of applicant.

THE UTAH ELECTRIC CLUB.

The Utah Electric Club was organized with 140 charter members on December 5 at Salt Lake City. This new club is destined to become one of the leading commercial and technical organizations of the State. Its object is to promote the social intercourse, recreation and culture of the members, and to advance the commercial interests of Utah. Any person interested in any branch of the electrical industry may become a member.

The following board of directors was elected for the ensuing year: President, C. B. Hawley, manager of the Intermountain Electric Company; Vice-president, H. R. Bucks, chief electrician of the Oregon Short Line Railroad; Secretary-Treasurer, W. W. Torrence, manager of the General Electric Company, John Jones, manager of the Westinghouse Electric Company, H. M. Fennemore, of the Mountain States Telephone & Telegraph Company, Leo Brandenberger of the Telluride Power Company, B. W. Mendenhall, of the Utah Light & Rail way Company, E. H. Eardley, of E. H. Eardley & Bro., R. S. Folland, manager of the Capital Electric Company.

Mr. Armstrong, president of the Commercial Club, invited the new organization to make its headquarters with the Commercial Club. This invitation was unanimously accepted.

The luncheon meetings will be held every Thursday noon at 12:15 in the Commercial Club Building.

H. T. Plumb, engineer of the General Electric Company, was elected chairman for December, H. F. Holland, of the Simplex Heating Company, chairman for January, and Bruce Cramer, chairman for February. These gentlemen constitute a program committee in charge of the weekly meetings.

OREGON ELECTRICAL CONTRACTORS' ASSOCIATION

A great deal of interest is being manifested in the forthcoming first annual convention of the Oregon Electrical Contractors' Association at Portland, December 17 and 18. The jobbers particularly, and their salesmen, are displaying a commendable spirit of co-operation and the visitors will be treated with a continuous performance in the way of entertainment by the sales force between the formal sessions.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

THE RELATION OF THE OREGON ELECTRICAL CONTRACTOR TO THE UNDERWRITERS' INSPECTION WORK IN OREGON.[1]

BY F. D. WEBER.

To accomplish these results would seem simple, and it would be if the defects were all "cut and dried" and always violated in one way.

Nevertheless we have a system which we believe is as near perfect as any can be made.

Exhibit "A" shows standard form of notice sent out. At both top corners are our office system of filing and insurance identification marks. Then comes the formal letter, followed by the street location. Below this follows a certificate of correction and instruction for the filling out and signing of same. And last a list of defects referred to by number.

EXHIBIT "A."

Hasbrouck Map
Block.....
Sheet.....
Map No.....

UNDERWRITERS' EQUITABLE RATING BUREAU
508 SHERLOCK BUILDING
PORTLAND, OREGON

Page.....
Rating.....

ELECTRICAL INSPECTION REPORT

Under certain circumstances an electrical defect must cause fire. This fact being well established, we feel that it is only necessary to call your attention to the following described electrical defects in order that they may be remedied. May we rely on you to notify us within a reasonable time from receipt of this letter that the defects have been corrected and made to conform to the requirements of the National Electrical Code? Defects noted below have been reported on existing in electrical equipment of your property by our Electrical Inspector in his report.....

.....
Secretary

City ..... Owner .....

Street .....

Between ..... and .....

Building ..... Occupant .....

☞ The Deficiencies noted by number at bottom of page refer to index on other side and enclosed sheet.

Fill Out Below When Deficiencies Are Corrected and Mail Entire Sheet to Underwriters' Equitable Rating Bureau

CERTIFICATE OF CORRECTION

.....191....

This is to certify that the defects referred to above have been corrected as follows:

.....

.....

.....

.....

.....

.....

(Signature).....

NOTE—This certificate must be signed by some official of the Electric Light Company, Contractor doing the work, or City Electrical Inspector, before being accepted, and is accepted only pending re-inspection by the regular Electrical Inspector of the Bureau.

DEFECTS: .....

.....

.....

Enclosed with this sheet is Exhibit "B" a printed list of defects. This is a perpetual list, as the decimal idea of indexing is followed. When a defect gets a number it will always have this number. New defects can be added under any heading by adding a new number, and defect. This makes this list applicable to any town and all towns.

It is well to add here that when the inspector is doing the actual work in the field he uses only an ordinary stenographer's note book for his notes. When in the office he places it under the office number system. In the field the numbers are too hard to handle.

When these new defects are added they do not appear on the printed list immediately, but are written out with the proper number on the back of the sheet, Exhibit "A," and in time will be added to the printed sheet.

Exhibit "C" shows form of letter used to notify owners and tenants when we have readjusted their insurance rate.

Exhibit "D" is a letter we issue when we find defects have been corrected to our satisfaction.

Exhibit "E" is the office sheet for our records, which contains the whole history of the inspection as regards any particular risk.

Exhibit "F" shows printed reports as issued on cities and towns after the first reinspection. These are for our use only—not under any circumstances given to the electrical contractors.

Instead of the old 25 per cent increase for defective wiring, whether consisting of minor defects or in a very hazardous condition, we have revised our charge and try to use judgment in making the following graded charges as an increase to the rate: Fair, 5 per cent; poor, 10 per cent; hazardous, 15 per cent; very hazardous, 15 per cent; trolley current, 25 cents; defective moving picture booth installations, flat charge of $1; up in bricks and in frame buildings, $1.50 to $2.50.

To also carry out a system of inspection and get the best results, we must have an intelligent body of contractors. In so many cases contractors take our notices and correct a defective installation, as they think is proper, but make as

EXHIBIT "B."

JAMES N. McCUNE, Secretary
P. O. BOX 749

TELEPHONES Main 124
A 4297

UNDERWRITERS' EQUITABLE RATING BUREAU
508 SHERLOCK BUILDING
PORTLAND, OREGON

INDEX OF DEFICIENCIES

ADJUSTERS:
1. Unapproved cord adjusters.

ATTICS:
16. Attics not properly lined and lathed.

BOXES:
26. Tubs not placed on outlet boxes.
27. Outlet boxes loose.

CONDUIT:
33. Approved rigid or flexible conduit not used.
34. Conduit not lathed to cabinet (a) or fittings.
35. Conduit not properly grounded.
36. Conduits off of conduit.
37. Service conduit must extend to main line cutout or into cabinet if same is required.

CORDS:
50. Flexible cord not standard.
51. Flexible cords too long (a) or used other than as pendants.
52. Flexible cords in show windows.
53. Lamp cords in bed shops (a) or hung on metal hooks, nails or grounded materials (b) or run through partitions.
54. Pendant cords ornamented with tinsel paper or gimps.
55. Portable lamps, motors, fans or fixtures not connected through re-inforced cord.
56. More than one cord in a rosette.
57. Pendant cords without knobs in fittings.
58. Pendant cord attached to grounds without approved fittings.
59. Unapproved cord adjusters.
60. Cord circular.
61. For pendant cords in wet or dusty places use stranded brewery cord or packing house cord soldered direct to circuits but supported independently; also weather-proof sockets must be used.
62. More than one light on pendant cord without approved fittings.

CLEATS:
100. Three-wire cleats are prohibited.
101. Wires attached with wood cleats, staples or nails.
102. Cleats should not be concealed.

CABINETS:
110. Cabinets not properly made (a) or lined.
111. No doors on cabinets.
112. Cabinet doors not lined.
113. Wooden cabinets used with iron conduit.

CIRCUITS:
120. Circuits overloaded.
121. Circuits overfused.

FITTINGS:
130. Broken fittings.
131. Loose fittings.

FUSES:
140. Unapproved (a) or improper use of open link fuse holder.
141. Too many lights dependent on final line block.
142. Cartridges from block bridged with spring fuse or wire.
143. Improper fuse block (a) or none at entrance.
144. Are lamps not fused individually.
145. Fuse blocks located over or near inflammable material.
146. 250-volt lamps on 220-volt circuits.
147. Fuses too large to protect circuit.
148. Refilled (a) or reinforced fuses.

FLEXIBLE TUBING:
170. Flexible tubing too short at outlets.
171. Flexible tubing used through floors or in damp places.
172. Service wire bushed with flexible tubing; must be porcelain or conduit.
173. Every wire more than 6 inches apart must be encased in a continuous piece of flexible tubing.

FEEDERS:
180. Feeders overloaded.

INDEX OF DEFICIENCIES—Cont'd

FIXTURES:
210. Electric fixtures not properly installed.
211. Fixture canopies on top of circuit wires or pendant switch wires.
212. Not properly insulated.

FOOTLIGHTS:
220. Footlights not standard and in a dangerous condition.

HAZARDOUS:
230. Installation in such a hazardous condition, that same should be completely re-wired.

INSULATORS:
240. Improper canopy insulator or none preventing contact between canopy and steel ceiling, gas pipe or grounded surfaces.
241. Cross-over tubes or insulators not properly fastened to plate.
242. Insulating-joints should be used where fixtures could otherwise become grounded.

JOINTS:
250. Joints not soldered, (a) or taped, (b) or properly made.
251. No rubber tape on joints.

LAMPS:
270. Lamps hanging against woodwork.
271. Open arc lamp inside of building.

LOOPS:
290. Bad or loose connections at fuse blocks and switches.
291. Switches loose.
292. Fixtures loose from support.
293. No support provided for fittings.

LUGS:
300. No terminal lugs used.

MOULDING:
310. Moulding not properly made (a) or painted, (b) or used in damp places.
311. Moulding without capping.
312. Moulding run on grounded surfaces without backing.
313. Soft wood moulding used instead of hard wood moulding.
314. Moulding installed without tagging.

MOTORS:
320. Motor overheated.
321. Motor should be enclosed.

OUTLETS:
340. Outlets not in use should be thoroughly taped up.

PROTECTORS:
350. No protector (a) or improper protector at entrance on telephone or signal wires, (b) or protector improperly located.

RECEPTACLES:
360. Lamp receptacles with exposed lugs or contacts in show window.
361. No cut-loose under snap switch (a) or receptacles.
362. Unapproved receptacles.

ROSETTES:
370. Unapproved rosettes.

SHEETSTAYS:
380. Sheetstays not properly mounted.

SWITCHES:
390. Improper switch (a) or none on flat or motor circuit.
391. Improper switch (a) or none at entrance point.
392. Entrance switch improperly located (a) or not readily accessible.
393. Entrance switch (a) or fuse on house side of meter.
394. Knife switch inverted (a) or bushed on live side of entrance base.
395. 120-volt switch on 220-volt circuit.
396. No cut-loose under snap switch (a) or receptacles.
397. Switch and cutout must be placed in approved cabinet.
398. Main service switch and fuse too far from the entrance of service wires to building.

INDEX OF DEFICIENCIES—Cont'd

399. Motor switch and cutout must be placed in cabinet.

SIGNS:
420. Electric signs not constructed and installed according to National Electrical Code.

SOCKETS:
430. Lamps reckless not bushed.
431. ½-inch sockets used on re-inforced cord instead of ⅜-inch sockets.

SWITCH BOARDS:
440. Not constructed in skeleton form of hard wood, slate, marble or approved composition.
441. No approved ground detector.

TROLLEY CURRENT:
450. Current for motor (a) or lights taken from trolley current.

THEATERS AND MOVING PICTURE ESTABLISHMENTS:
460. Not installed in approved conduit.
461. Footlights, borders or strips not constructed according to National Electrical Code.

TRANSFORMERS:
470. Bell ringing transformers not properly mounted (a) or not of approved make.
471. Sign transformer not properly mounted (a) or not of approved make.

WIRE:
480. Wires of opposite polarity in contact (a) or too close together.
481. Service disconnected, but wire still attached to building.
482. Wires not bushed at entrance.
483. Wires spliced or too close to grounded pipes or improperly protected.
484. Wires not protected where liable to mechanical injury.
485. Wires in contact with outside awning (a) or with metal front or side of building.
486. Telephone or signal wires in contact with (a) or too close to light or power wires.
487. Wires not bushed (a) or bushed improperly through walls, floor or partitions.
488. Wires of opposite polarity through one bush.
489. Wires too small for current carried.
490. Wires not attached rigidly in position (a) of loose from support.
491. Other than rubber covered wire used for concealed work.
492. Wires not properly separated in concealed work.
493. Wires not supported at sufficiently frequent intervals.
494. Solid wires used as conductors to switchboard or movable lamps.
495. Wires not entering conduit properly at cleanest point knob and tube to conduit work.
496. No fuse used where change is made in size of wire.
497. Service wires in bad shape or not properly attached to or insulated from building.
498. Wires in contact with other materials than insulation.
499. Unapproved wire.
500. Porcelain supports for wires fastened to grounded surfaces.
501. Overhead wires.
502. Wires not properly supported over roofs.
503. Wires and open work not properly spaced.
504. Wires held in place by the wires on wires smaller than No. 7 B. & S. gage.
505. Bare wires.
506. Wires knobbed (a) or clouted over (b) partitions.
507. Dead circuits and wires should be removed.
508. Clouted (a) or knobbed over grounded surfaces.

WIRELESS TELEGRAPH:
600. Not properly installed according to requirements of National Electrical Code.

NOTE—Example to illustrate use of above: Given defect, "505." This should be read, "Wires of opposite polarity in contact." Had given defect been "4805" this should then be read, "Wires of opposite polarity too close together."

many violations of the code as the original notice pointed out.

These errors come principally from ignorance of the rules and requirements. It is very discouraging when we realize what a small percentage of the electrical contractors read the N. E. C. intelligently. So many are still bound by the old traditional prejudice against the code and are contented to say it is "indefinite," "contradicts itself," and so "poorly indexed" that nothing can be found.

When the electrical contractor will spend a few hours of his valuable time trying to consistently understand the N. E. C. he will have no trouble, but if he allows it to lie in a dusty corner and hurriedly grabs it and thinks all the information will jump out when he presses the button, he will be sadly mistaken.

If after making an effort to understand the code he should fail to understand some point in regard to inspection and correction of defects, we always stand ready to give all the help and advice at our command. All that is necessary is for any one in doubt to call in person at our office or put their troubles in writing, and we will do everything in our power to give them a clear understanding of our desires in the matter.

We always wish to foster local inspections in the various cities, and have a standard electrical ordinance outline which can be adapted to the local needs of any community. These can be obtained upon application at our office.

To always keep the contractor advised, we send out electrical circular letters, such as Exhibit "G." These deal with local rulings and changes in the N. E. C. Annually we publish an addenda to the N. E. C., which is a summary of all changes, rulings, etc., to date. The circulation of all literature is limited to our mailing list, and any one interested should be sure their name appears there.

So far it all looks lovely, but now what influence does the local electrical contractor have on this system, outside the matter of correcting the defects themselves. Sometimes very

EXHIBIT "C."

On .....you were notified of defects in electrical installation in your property, ..., which under certain circumstances may lead to fire, and were requested to notify us of their correction. Sufficient time having elapsed and the defects still existing, it will be necessary to readjust the rate at once to meet this hazard.

Subsequent readjustment will be made on receipt of a "Certificate of Correction" signed by the City Electrical Inspector—or in absence of this official, by some official of the electric light company, or contractor doing the work—that the installation has been made to conform to the rules and requirements of the National Electrical Code.

Yours truly,

little, and again he can make it appear in a light which causes endless strife.

First—He is a resident of the community in which he has his place of business, has friends and more or less influence with the rest of the citizens, and if he is willing to do missionary work and tell owners and tenants why we require changes, and that our only purpose is to reduce the fire hazard and produce safe conditions, instead of saying we are robbers and own stock in the great supply business and desire changes only to make business for the sale of materials and fittings, he will make the system a great deal more efficient, also impress upon everybody that the electrical business is governed

EXHIBIT "D."

This is to certify that the electrical defects as pointed out in our notice of.....in regard to property located .....
have been corrected in a satisfactory manner.

by a National Code of undisputed authority, and is not a haphazard business, dependent upon any one man's "hobby."

Second—The electrical contractor may be a competent contractor, and understand his business, or he may be a careless workman and not understand code rules and requirements.

EXHIBIT "E."

No. _____ Form 1

TOWN OF _____

NUMBERS REFER TO SANBORN MAP. 1 _____ Inspected _____ 191__

Name of Owner or Person to Notify	Sheet No.	Block No.	Lot No.	Street and Number (Refer to Index of Deficiencies)	Defects

Reinspected		Notified			Letters and Inquiries			Certificate		Rates Adjusted	
Date	By Whom	Date	Whom	Form	Date Received	From Whom Received	Date Answered	Date	Signed By	Date	How

Third—He may be honest and try to do the best he knows how, or he may run a "skin game" in all his dealings.

Fourth—He may be content with legitimate profits, or he may be exorbitant in his charges.

Fifth—He may be willing to put in all new work, according to the rules and requirements of N. E. C., or he may not.

Therefore you see honesty in its broadest sense and cooperation is what we desire from the electrical contractor in

EXHIBIT "F."

UNDERWRITER'S EQUITABLE RATING BUREAU.

Electrical Report.

Original Inspection June 3 to 9, 1912.
Re-inspection October 23 to 26, 1912.

The ..... supplies electric energy to ..... Current is transmitted at 23,000 volts and stepped down within the city limits to 2200 volts, at which pressure it is distributed by a common circuit to both light and small motor users. A separate power circuit is provided for large motors, and this includes the ..... at 220 volts and the city pumping plant at 2200 volts.

All service transformers for lighting are 2200-110 volt. Those for power are 2200-220-110 volt. All neutrals are grounded.

At substation three 250 kw. water-cooled transformers are in delta connection. These are 23,000-2300 volt.

The company maintains two arc circuits, one for business streets and one for residence streets. Sixty-three series arcs are used and these are about equally divided between the two circuits. Voltage of arc circuits, between 2500 and 3000 volts.

The Fire Marshal has authority to make electrical inspections, but no real inspection of the city has ever been instituted in the past, for the reason that the Fire Marshal is the only electrical contractor in the city.

The Western Union Telegraph Company maintains a 21 clock, 65 volt circuit energized from gravity cells.

All telephone entrances to buildings are protected by Pacific Telegraph and Telephone Company's standard arrester.

Oregon, to aid us in making our system of inspection a complete success.

The feeling of antagonism against the bureau should pass away with a clear understanding of our methods and ideals and be replaced by a true loyalty on the part of every

"G."

ELECTRICAL CIRCULAR NO. 40.

To Electrical Contractors, Wire Manufacturers, Jobbers and the Electrical Trade in general:

Rubber-Covered Wire.

Gentlemen:

Referring to our previous Electrical Circulars Nos. 36, 37 and 39, on rubber-covered wire, flexible cord and armored cables, we beg to advise that after January 1, 1913, this Bureau will not sanction the installation of any of these products—under any conditions—unless same conform to the 1911 "N. E. C." specifications and have the proper "Underwriters' Laboratories" label attached.

Yours truly,
UNDERWRITERS' EQUITABLE RATING BUREAU,
F. D. Weber, Electrical Inspector.

electrical contractor—as we are the very life and essence of his business—and are trying to be absolutely square to him. We desire a "square deal" and also desire the owners and the contractor to get the same.

(To be continued.)

INDUSTRIAL

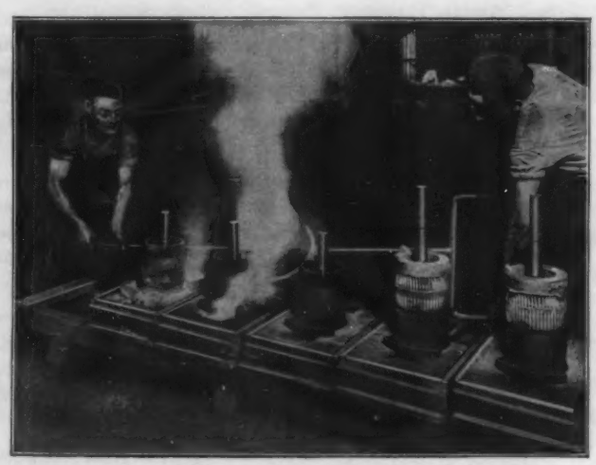
INDESTRUCTIBLE SQUIRREL CAGE ROTORS FOR INDUCTION MOTORS.

The squirrel cage induction motor has long been recognized as the most substantial and reliable of any class of power apparatus. However, there has always been one detail of construction that has caused more or less trouble even in the best of designs.

This detail is the joint between the rotor bars and the end rings. These joints, of which there are two to each bar, have to carry low voltage currents of great volume, especially while starting, and consequently anything less than perfection at this point becomes the occasion of extreme local heating, sometimes followed by the ultimate rupture of the joint, and perhaps such arcing and burning of the bars and end rings as to necessitate expensive repairs.

Various forms of screwed joints, riveted joints and soldered joints have been employed with more or less success, but it has been known by engineers that so long as there was any joint at all between the bars and the rings, there were just so many points of possible failure under operating conditions of extreme severity, and there has been no jointed rotor construction which has not proved this by showing more or less failures at this point.

The solution of the indestructible rotor problem, then, means a rotor without joints, and this has been accomplished in the cast-on end ring construction recently devised by the engineers of Fairbanks, Morse & Co., which is shown in the accompanying illustrations.



Casting Rotor End Rings at Electrical Factory of Fairbanks, Morse & Co.

The illustration shows the operation of casting so clearly that little explanation is required. The rotor bars are assembled in the core, and the end rings of either brass or copper are cast around the ends of the bars. The treatment of the bars and the process used being such that a perfect fusion of each and every bar with the metal of the end ring is secured, and a "cage" produced as solid and indestructible as if it were made in one piece. At the left of the picture the operation of casting the first ring on a rotor will be clearly seen, and at the right of the picture are two rotors upon which the first ring has been cast and the moulds prepared for casting the second ring. This illustration shows in a striking manner the fact that rotors thus prepared will hardly be subject to injury from any degree of heating that they will ever be subjected to in subsequent service.

After casting, the rings are finished and a deep groove cut into each ring down to the union of the bars and the rings, so that the integrity of each weld can be inspected.

TRADE NOTES.

The Pacific States Electric Company announce their occupancy of the new home recently erected for them at Nos. 575-77-79 Mission street. The new plant is a model supply house in every detail; the ground floor being devoted to sale and display room, while the upper ones are occupied as offices and store rooms.

NEW CATALOGUES.

The Crocker-Wheeler Company of Ampere, N. J., is distributing two new bulletins, Nos. 150 and 158. The former deals with coupled and belt types of alternating current generators, while the latter describes adjustable speed motors.

The Westinghouse Electric & Manufacturing Company are distributing a number of attractive catalogues, leaflets and folders. No. 1203 is a very handsome catalogue on the Westinghouse Electric Ignition and Lighting System and other accessories for gasoline automobiles. Descriptive Leaflet 2441-A gives instructions on the operating characteristics, mounting and method of drive of a.c. and d.c. motors. Leaflet No. 2485 is devoted to the application and operation of low-pressure steam turbines. Folder 4231 covers the application of Westinghouse motors to various services. Folder 4241 illustrates and describes Types C and OA Watthour Meters. Folder 4320 is concerned with polishing and grinding motors. Textile Quarterly No. 2 is devoted to motor drive in worsted and woolen mills.

BOOK REVIEWS.

Alternating Current Machinery. By William Esty, S. B., M. A. Size 7½x9½ in.; 467 pages; 409 illustrations; cloth binding. Published by the American School of Correspondence, and for sale at the Technical Book Shop, 106 Rialto building. Price, $3.00.

This book is a practical treatise on alternating current principles and systems, commercial types of alternators, synchronous motors, transformers, converters, induction motors, switchboard and station appliances. The author is well known in electrical engineering circles. As professor of electrical engineering at Lehigh University and author of a text-book on electrical engineering which has gained wide usage in American technical schools, he needs no further introduction. Alternating current phenomena is difficult of elucidation at best. In this book, however, the reader is taken over the road in easy, simple stages, by a path devoid of difficult mathematics. For the student endeavoring to master the fundamentals of alternating current machinery and phenomena, and who must travel the road alone, the book is strongly recommended.

Primary Battery Ignition. By C. Wadsworth, Jr. Size 5x7½ in.; 78 pages; 26 illustrations; cloth binding. Published by D. Van Nostrand Company of New York, and for sale by the Technical Book Shop, 106 Rialto building, San Francisco. Price, 50 cents.

This booklet is a simple, practical pocket guide on the construction, operation, maintenance, and testing of primary batteries for automobile, motorboat and stationary engine ignition service. Automobile fiends and the layman who has at times the operation of primary batteries will find the book most useful and helpful.

NEWS NOTES

INCORPORATIONS.

HELENA, MONT.—Articles of incorporation have been filed of the Montana Eastern Railway Company, which is to to construct a line out of Lewiston to the east to meet the main line of the Great Northern at New Rockford, N. D. The company is capitalized at $10,000,000. Head offices will be established at Lewiston.

VANCOUVER, WASH.—The Northwestern Electric Company has filed a declaration of intention to do business with capital stock of $10,000,000. It proposes to generate, transmit and furnish electricity for heat, light and power and operate railroads, lumber mills, mercantile establishments and telephone and telegraph lines. H. A. Mitchell is president and Chas. Barnard of Portland is general agent.

ILLUMINATION.

MONTESANO, WASH.—A franchise has been granted the Elma Electric Company over the county roads to the town of Satsop.

CHINO, CAL.—The Southern California Edison Company has been granted a gas franchise. According to present plans work on laying pipes will begin about January 15.

GRANTS PASS, ORE.—The "Jimmie Quinn" ditch at Takilma has been purchased by C. E. Phillips and Elmer Dunn, who will put in an electric plant.

LOS ANGELES, CAL.—The Southern California Edison Company has filed an application for a franchise to lay gas mains in the streets of Wilmington and San Pedro.

KENNEWICK, WASH.—The contract has been let by the Pacific Power & Light Company for the construction of a large warehouse on property adjoining its present location.

BEAUMONT, CAL.—Representatives of the Southern California Edison Company of Redlands, state that they expect to apply for a franchise to market electricity in Beaumont as soon as the new city government is instituted.

SANTA ANA, CAL.—Bids will be received up to January 6th for the franchise applied for by the Southern Counties Gas Company for laying a system of gas pipes in certain portions of the city, for the purpose of conducting commercial gas for lighting, heating and fuel, for a period of 25 years; said franchise to be awarded to the highest bidder.

STOCKTON, CAL.—The Oro Electric Corporation, which is preparing to enter San Joaquin county to supply electric current for power and lighting, has filed an application with the Supervisors for a blanket franchise for a pole line in this county. The Supervisors advertised the same for sale, bids to be received January 7 next at 10 a. m. The franchise sought is to enable the Oro company to supply current to farmers in various parts of the county. Attorney C. L. Neumiller represented the applicant.

SACRAMENTO, CAL.—City Commissioner Wilder has announced new specifications for street and other city lighting which provide distinctive innovations in the call for sealed proposals to be published by direction of the city purchasing agent at once. The first bid is for incandescent lamps for various city buildings and public works, each location to be considered separately. Another bid will be for current for motors in the city wharf, city library and the city hall. For electroliers the bid will be for 110 volt current to be supplied to 500 electroliers of 250 watt capacity each, wired eight to a circuit. The next bid in the order in which they come in the specifications will be for providing the plant or equipment for street lighting. Next is for supplying power for the street arc lamps. It is proposed by the city to install electrically driven pumps for the city water works and in case such is done, bids will be considered on current for regular consumption. The Pacific Gas & Electric Company now holds the contract for furnishing electrical energy to the city, the contract to expire the first of next year. For the big 3000 candlepower street lamps the city pays $6 each month for each lamp, and there are more than 700 lamps in the city. The total amount paid to the Pacific Gas & Electric Company this year for lighting will be more than $60,000.

TRANSMISSION.

NANAIMO, B. C.—The Nanaimo Electric Light, Power & Heating Company, Ltd., plan extensive alterations and improvements to the plant.

NEW PLYMOUTH, IDAHO.—The Idaho-Oregon Light & Power Company expects to build several miles of line out of this city to farms in this district.

BOISE, IDAHO.—The Southern Idaho Light & Power Company and the Idaho Traction Company plan on making numerous improvements in this city.

NEW WESTMINSTER, B. C.—The Western Canada Power Company has secured a contract for supplying power to the D. factory of the Dominion Match factory and to the British Columbia Transport Company, Sapperton.

COQUITLAM, B. C.—The British Columbia Electric Company has secured the contract for supplying light and power to the C. P. Railway Company's roundhouse here and will shortly begin work of erecting a pole line to the property of the concern.

KAMLOOPS, B. C.—Du Cane, Dutcher & Company, Rogers building, Vancouver, B. C., announce bids will be received until December 19 for furnishing steam pumping and electrical equipment for the municipal power plant here, instead of December 5.

HELENA, MONT.—The legislature will be asked to appropriate $300,000 for completion of the state's hydroelectric plant at the racetrack between Warm Springs and Deer Lodge, the power generated to be used at the state prison, asylum and tuberculosis hospital.

CENTRALIA, WASH.—The Washington-Oregon Corporation will build a power line on the west side of Cowlitz River, between Kelso and Castle Rock, giving the town of Lexington electric current for light and power purposes. The line will also be extended across the river to Ostrander.

ASHTON, IDAHO.—According to well authenticated reports former U. S. Senator W. A. Clarke of Montana, recently purchased a power site near here on the north fork of Snake River and will expend three-quarters of a million dollars in constructing a power plant and stringing transmission lines into Montana and Idaho. Work will begin in the spring.

TRANSPORTATION.

LOS ANGELES, CAL.—Emmet H. Wilson has applied for a franchise to construct a street railway line on Vernon avenue, from Dalton avenue, to the west city limits.

SAN FRANCISCO, CAL.—As the franchise of the Presidio & Ferries Railway will expire December 30, 1913, the Super-

visors, on motion of Supervisor Koshland, have taken preliminary steps leading toward municipal ownership of the road. A resolution was adopted requesting the city attorney to report to the board a plan of procedure, including an opinion as to what rights the city may have in the roadbed. The city attorney also will outline the procedure necessary for the city to acquire the rolling stock and other physical property.

OROVILLE, CAL.—A loss of $13,000 to $15,000 was caused by a fire which destroyed the Northern Electric Company's depot here. The building loss is $4000. Defective wiring caused the blaze.

MONTEREY, CAL.—The Monterey & Pacific Grove Electric Railway Company has been granted a franchise on its bid of 1 per cent of its gross receipts annually for the first five years, and 2 per cent annually thereafter.

EL PASO, TEX.—A franchise for an electric railroad from El Paso down Rio Grande Valley to Ysleta, and deeds to rights of way are now in possession of Stone & Webster of Boston, and that corporation's representatives in El Paso are already busy with preliminaries with a view to begin construction of the road.

SAN FRANCISCO, CAL.—Notices have been sent to the stockholders of the Sacramento Valley Electric Railroad Company calling a special meeting to be held in the executive offices of the company at San Francisco on Saturday, December 14, for the purpose of increasing the number of directors from five to seven. This action will be taken in order to make it possible for Solano county to have sufficient representation on the board of directors. The people of Solano contributed to the fund with which the survey was made through that county for the connection of the electric road from Woodland to a point below Dixon, where it will join the Oakland, Antioch & Eastern.

OAKLAND, CAL.—Alleging that the Oakland, Antioch & Eastern Railway is being built for the ultimate purpose of becoming the western terminus of a new transcontinental railroad, and that the traffic over such road would render Shafter avenue useless for residence purposes, H. P. Fry, Helen K. Fry and Fred W. Fry have filed suit against the corporation for $3800 damages to their property on that street and for an injunction restraining the defendant from operating trains over the tracks. A similar suit was filed by Blanche H. Cary, who asks $1000 damages. In regard to the suits President W. Arnstein of the Oakland, Antioch & Eastern, said: "Our franchise forbids the operation of steam trains. All the talk about a transcontinental road backing us is ridiculous."

RICHMOND, CAL.—Illumination of the business streets over which its new interurban electric lines will run, a 5c fare within the city limits, the designation of stations by the city and the payment of 2 per cent of the gross annual income of the road to the city at the expiration of five years, with the city to have the right of examination of the company's books to determine same, are the principal features of the revised draft of the franchise asked for some time ago by the Southern Pacific Company and last week accepted by the company at a meeting of the city council. The new franchise provides that the company may do freight hauling between the hours of 10 p. m. and 6 a. m., but provides that no freight cars can be left standing on any of the streets. Passenger traffic over the first division will commence early in the spring.

VALLEJO, CAL.—A case of interest to railway officials was decided by the Railway Commission, when it granted permission to the Vallejo & Northern, the Northern Electric's newly acquired subsidiary, to discontinue its passenger train service until the entire line is opened from here to Sacramento. The commission held that the earnings of the carrier on those portions of its line already completed are not sufficient to warrant operation. The decision is regarded as important because hitherto the railroads have followed a policy of establishing train service along their projected lines as rapidly as possible, operating trains over every mile of available track as the road became available. The commission's decision, however, is regarded as a sanction of the withholding of service until the entire line, as projected, is completed. The decision will have an effect on numerous towns in the State, which are situated on projected lines and which have expected the respective lines to be opened to train service as soon as possible. The Northern Electric's specific request was that it be allowed to discontinue service between Boynton and Armijo, and from a point on the Vallejo & Northern near Fairfield to Fairfield Junction.

OAKLAND, CAL.—Work is being rushed on the new East Oakland extension of the Oakland Traction Company's lines along East Sixteenth street and the Foothill boulevard. It was announced by the engineer that the line probably would be in operation within three weeks. The extension will mean the laying of 17,000 feet of double track at a cost of $172,500. It was necessitated by the rapid increase in population of the district through which it will pass and the great need for removing traffic as much as possible from East Fourteenth street, now the chief highway for nearly all traction cars of the East Oakland district. The new line begins at Thirteenth avenue and extends eastward on East Sixteenth street to Talcott avenue, to Twenty-fifth avenue, to the Foothill boulevard, to Courtland avenue, to Ignacio avenue, to Trask avenue. The recently completed extension of the Euclid line in Berkeley has been put into operation, supplying a car service to many districts in North Berkeley, Craigmont and Northbrae, which have hitherto been inaccessible. That the High street and East San Jose avenue line of the Oakland Traction Company in Alameda will be broad gauged by March 1 was promised at the meeting of the City Council by Assistant General Manager J. P. Potter of the street car company.

TELEPHONE AND TELEGRAPH.

METALINE FALLS, WASH.—The Bell Telephone Company has applied for a franchise throughout the county.

DAYTON, WASH.—The Patit Telephone Company has been organized and will operate about 50 miles of telephone lines.

PRESCOTT, ARIZ.—With the completion of the double tracking of the main line of the Santa Fe between Yavapai and Ash Fork, the Postal Telegraph Company will install telephone service between Seligman and this city.

CLE ELUM, WASH.—The Pacific Telephone & Telegraph Company has been granted the right to erect poles, wires and other appliances for the transmission of electricity for telephone and telegraph purposes in, upon and under the public highways of the city.

EUGENE, ORE.—A new telephone company has been organized under the name of The Lancaster Telephone Company No. 2. Hans Albertson has been elected president. The new line will be four miles in length and will run from Lancaster west to Naraton into Junction City.

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Wanted and For Sale

The rate for advertisements in this column is $1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue.

Replies may be sent in care of the Journal of Electricity, Power and Gas, Rialto Building, San Francisco.

FOR SALE.—One second-hand Weston D. C. ammeter, 0 to 50, in perfect operating condition; $10.00. J. E. McGillivray, Boise, Idaho.

E. C. HUGHES, PRESIDENT ADOLPH MEESE, SECRETARY

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